Efficiency and Usability of E-Learning Systems: Project-Oriented Methodology Guide

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Overview

The Guide presents the efforts of the NBU team to put forward an integral methodology for evaluation of E-Learning systems. It has been created within the WELKOM project financed by the Leonardo da Vinci EC program. The methodology given here has been applied successfully for deploying and optimizing three different E-Learning systems in three different contexts – a private industrial company (Turbomeca, France), a SAP training company (VBS, Bulgaria), and a university (NBU, Bulgaria).

The main principles that underlie this methodology are educational effectiveness and efficiency, and usability. These principles are implemented by using evaluation methods which guide and inform the E-Learning deployment process during the analysis, design, development, implementation, and performance phases.

The guide has the following structure:

In Section 1 the general theoretical and methodological grounding principles of the methodology are discussed.

In Section 2 the phases and the methods of the methodology are presented with discussion of the results expected from each of them and how they influence the E-Learning implementation.

Section 3 and 4 are aimed to be a practical guide of how to apply methods for educational effectiveness and efficiency and usability, respectively. It can serve as a reference of the methods used with a detailed description of their goals, results, procedure etc. Several important methods are presented in a format that allows immediate application by a professional with only a few changes.

Appendices A and B provide ready-to-use questionnaires, forms, and tests which complement the methods described in Section 3 and 4.

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SECTION 1
General Principles

Introduction

The Guide presents the efforts of the NBU methodological team to present an integral methodology of evaluation of E-Learning systems from two perspectives – educational effectiveness and efficiency, and usability.

The methods chosen and the timing for the application are aimed to be general enough in order to make the methodology applicable to various E-Learning systems. It should be noted however, that the adaptation of the methodology might require some adjustments for any specific use to take into account the specific features of a particular E-Learning system and training context. However, we hope that the core methodology presented in this guide will make such adjustments relatively simple.

The key features of the methodology developed are the following:

- the analysis takes into account **various aspects** of E-Learning Systems efficiency related to **educational effectiveness and efficiency,** and **usability**
- the E-Learning deployment is considered to be a **process** consisting of several **phases**
- various **tests** should be performed during each phase of the design, development and implementation of a E-Learning System and the results should be used to continuously improve it
- the analysis procedure should be **iterative** – i.e. performed several times until the needed level in terms of acquired knowledge, skills and attitudes is reached.

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1. Phases in E-Learning system development

The methodology as a whole is based on the widespread model of building training programs, known as Instructional System Design (ISD) or System Approach to Training (SAT). The basic features of these approaches are:

- Precise specification of the abilities needed by the trainees – the trainees are expected to acquire knowledge, skills and/or positive attitudes, which are necessary to perform efficiently their specific tasks
- Clear definition of distinct phases in training, which allow precise building and adjustment of the training program
- Repeated evaluation of the training program – it allows the training to be changed and improved at each stage and with respect to all its characteristics – content, interface, etc., in order to achieve optimal performance.

ISD and SAT are based on the idea that training is an on-going process. The application of this approach guarantees that training programs will be continually improved in an effective and efficient manner to match the training needs of an organization.

The SAT defines the following phases:

Phase 1. Analysis

Comprises activities intended to gain a complete understanding of the organization (as a whole or its departments, units, jobs, etc.). The problems and shortcomings are investigated and the decision if they could be solved by training is made. If so, the problems and shortages are analyzed in performance terms and the performance gap is examined. Usually a task inventory of all tasks associated with a particular group of similar jobs serves as a basis of the training needs analysis which is the core of the Analysis phase. The tasks that need training are selected and, if necessary, the performance measures (or performance standards) are set. The multitude of the tasks selected, their relative importance and compliance with the organization's goals is regarded as a basis of the future training program curriculum.

Phase 2. Design

On the basis of the information collected at the previous phase, the overall learning (educational) objectives and the learning objectives for each task are formulated. Then these objectives are set in the order which gives the sequence of the learning steps. According to that sequence the curriculum is developed, which is regarded as a specific framework for learning that shows what is intended to be taught. It is a specific plan derived from training needs assessment and performance standards, which is multidimensional and in broad terms includes subject topics, lessons, assignments, resources, and sometimes assessments. The content of each step (e.g. lesson, module) is described in broad terms. A delivery method (e.g. classroom-based, WEB-based etc.) is selected. If needed, some supporting teaching materials are provided. As a result, a complete model of the training program is designed.

Phase 3. Development

This is a phase in which the design of the training program, worked out during the previous phases, is transformed into a complete product (courseware), which is ready to be delivered.

Phase 4. Implementation

This is the phase in which the actual training takes place.

Phase 5. Evaluation

Each previous phase of the training process – analysis, design, development, and especially implementation – is reviewed and evaluated in order to ensure its internal consistency and compliance with the learning objectives and the organization's needs as well. On the basis of evidences provided, the entire training program or its different aspects is revised in order to make it effective and efficient.

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 ISD process and consider the evaluation as an on-going activity throughout the whole deployment cycle.

That is why in this methodology, the fifth phase 'Evaluation' is considered a continuous activity which covers all of the phases.

2. Kirkpatrick's four-level model

D. Kirkpatrick (e.g. Kirkpatrick & Kirkpatrick, 2006) proposes a model for the evaluation of educational effectiveness. It is known as the Kirkpatrick's four-level model which is now considered an industry standard across the HR and training communities.

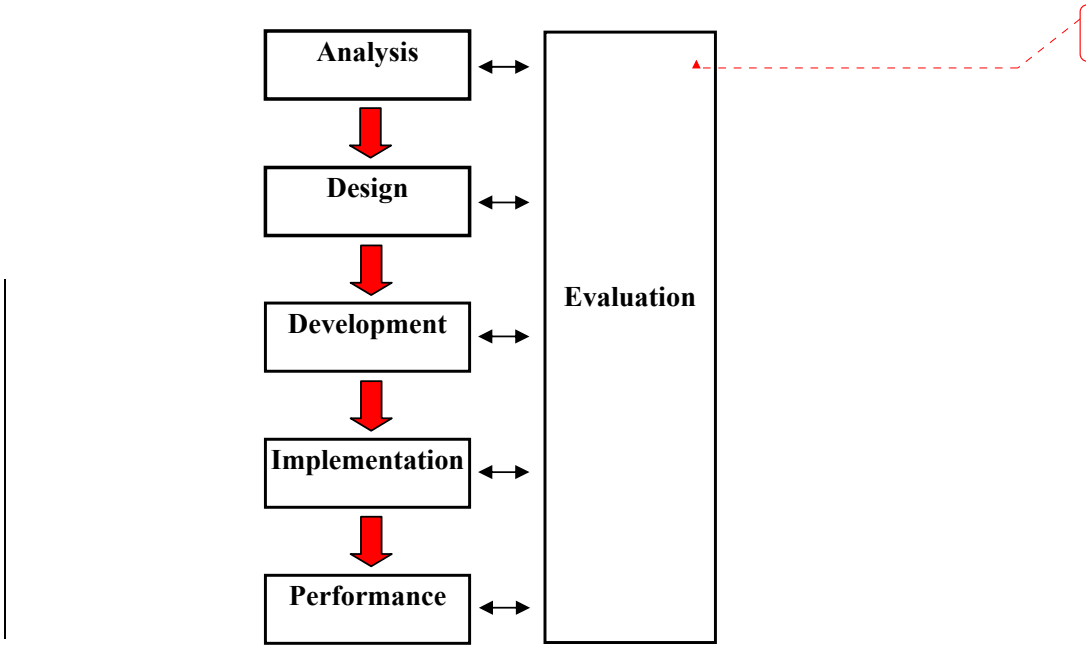
The four levels of Kirkpatrick's evaluation model essentially measure:

- **Level I. Reaction of learners** – what they thought and felt about the training
- **Level II. Learning** – the resulting increase in knowledge or capability

- **Level III. Performance** – how well the learners apply what they learned in their places of work after the training
- **Level IV. Results** – the effects on the business or environment resulting from trainee's performance on the job.

3. Main features of the methodology

In this guide, the ISD model (the phases of E-Learning systems development and evaluation as an ongoing process) and the first three levels of the Kirkpatrick's model are taken into consideration. The model obtained is presented in Figure 1.



Форматирано: Шрифт: Получер, Английски (САЩ)

Figure 1. Phases of the E-Learning design and development.

Figure 1 shows that evaluation is not something done once the training is over, but is parallel to it and carried out at each stage. The two-sided arrows indicate that after collecting the necessary information about the corresponding phase, one could take some immediate actions (measures) to improve the output (for instance to improve the *model* in the Design phase or the *courseware* in the Development phase). An additional advantage is the opportunity to *predict* the educational effect (effectiveness) of the training delivered (especially at the Implementation and Performance phases) on the basis of information gained during previous phases.

In order to achieve further increase in effectiveness and efficiency, after building and implementing the training program, the ISD process can be repeated after having taken into account all the improvements suggested by the evaluation procedures in the previous iteration.

The methodology guide is built with the understanding that training programs should be evaluated taking into account several complementary aspects.

- The first aspect is the educational efficiency. It concerns mainly the content of the training program and especially the degree of knowledge and skill acquisition as a result of the training. It also concerns what the time and efforts required to reach a certain level of knowledge are.

- The second evaluation aspect especially important for E-Learning systems is the usability of the system. It concerns mainly the evaluation of the delivery method and the computer interface used for the interaction of the learners with the system. On the other hand, it can also be applied to the content in terms of structure, presentation, etc.

Some of the methods proposed in this Methodology give guidelines on how to build efficient E-Learning systems while others provide means for evaluation of E-Learning systems.

4. Educational effectiveness and efficiency

Educational effectiveness is considered to be a measurable feature of the training process and is related to how well it achieves its intended educational objectives. Educational effectiveness relates mainly to the content aspects of the training program and could be measured in different ways. Educational efficiency measures the amount of time and efforts needed to achieve a training goal.

The methodology offers a variety of methods, which enable various evaluations of the training process and contribute to both educational effectiveness and efficiency. Each phase of the E-Learning deployment is supported by at least one such method (except for the Development phase when evaluation is not needed).

The educational effectiveness and efficiency part of the methodology comprises 12 different methods[1]:

1. Survey of managers (Method E1)
2. Survey of experienced employees (Method E2)
3. Gap analysis (Method E3)
4. Learning styles evaluation – Kolb's Learning Styles Inventory (LSI) (Method E4)
5. Preferred modality of information acquisition (VARK questionnaire) (Method E5)
6. Attitudes to computer (Method E6)
7. Free classification (Method E7)

[1] In the text the methods for testing the educational effectiveness are prefixed by the letter 'E' (from Educational)

8. Tutor's diary (Method E8)

9. Happy sheets (Method E9)

10. Achievement tests (Method E10)

11. Observation of the performer's work (Method E11)

12. Survey of key people (Method E12)

The rationale for suggesting these methods and the general description of each of them is given in Section 2. More detailed and comprehensive descriptions are given in Section 3.

5. Usability testing

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). These terms can be defined as follows:

- **Efficient** use of the E-Learning System is related to the productivity, as work accomplished per unit time
- **Effectiveness** is related to how well users are able to perform the task
- **Satisfaction** is determined by users' subjective experience.

This methodology consists of four different methods that provide valuable information concerning the E-Learning system usability. Each of these methods assesses the usability of the E-Learning system from a different point of view and with respect to different dimensions of usability. Therefore, the methods proposed are by no means interchangeable or substitutable. Rather, the methods are complementary to each other and allow achieving a complete usability evaluation of the system.

Proper application of all four methods would give important directions for improving the usability of the system.

The guide includes the following methods[2] concerning usability validation:

- Heuristics evaluation (Method U1)
- User testing (Method U2)
- Questionnaires and attitudes measures assessing user satisfaction (Method U3)
- Eye-tracking recordings (Method U4).

The short description of the usability testing methods and their implementation during the different phases is given in Section 2. Detailed description is provided in Section 4.

[2] In the text the methods for testing the usability are prefixed by the letter 'U' (from Usability)

6. Stopping criteria for the iterative procedure

The methodology for measuring educational effectiveness and efficiency can be applied many times in a series. The question arises when to stop such an iterative procedure. It is possible to use at least two approaches to establish stopping criteria:

1. The first approach is known as the criterion-reference stopping rule. In this approach, the amount of knowledge and skills which the learners acquire is compared to the required knowledge. When all learners achieve a pre-specified sufficiently high level (e.g. 90 %), the iterative procedure of improvement of the learning process is stopped.

2. The second approach is known as the learning curve criterion. In this approach, the speed of improvement of the learning process is estimated after each iteration and the process is stopped when it is less than a pre-specified limit (e.g. 10 %).

Both methods can be applied together or separately for each part of the course and thus focus the improvement efforts only where they are needed.

7. Key players

Training could be viewed as a complex process involving various types of activities and people, who plan and implement them. In practice the same people could take part in more than one kind of activity and assume different roles. That is why the following descriptions should be regarded as descriptions of the functional players and their roles.

The Training management team is a group of people within an organization, who are in charge of the training process. In an organization, this role usually is played by a particular unit, for instance Human Resources and Development or Personnel Department or other structures which handle HR functions. Generally, the HRD structures are committed to developing staff knowledge and skills. That is why such kinds of structures often include training managers and/or a specialized group to promote learning among the staff.

In the case of small organizations where a training manager or personnel chief handles HR issues and where a concrete training could be regarded as a project, a temporary *training management (or training project) team* is formed. It consists of competent (line) managers with one of them (preferably with HR background) as a team leader. The team plans the workflow of the training activities (training programme), implements them and/or assigns (some of) them to third parties.

The Methodological/analytical team is a group of experts, who assist the *Training management team* in providing a better training. The methodological team adopts and/or defines a set of indicators, chooses and/or develops appropriate methods for assessing each of them, analyzes data collected and makes recommendations to the *Training management team*. As mentioned above, in the case of E-Learning, two major sets of indicators (or training aspects) are monitored and controlled: educational and usability. Accordingly, two kinds of professionals are included in the

methodological team: experts in educational measurement (mostly in psychometrics and statistics) and in usability.

The Instructional design group is a group of experts who take part in the design phase of the E-Learning System development. This phase follows the analysis of an organization's training needs. The Instructional design group applies instructional learning theory and develops a learning program tailored to the training needs revealed in the Analysis phase. In particular, it produces a detailed plan for the training (the so-called design document) or a 'script' or a 'storyboard' of the training programme.

Usually the people from this group are members of the *Training management team*. In some cases the *Training management team* could assign the task to an outside organization, specialized in HRD and training.

The Developers are a group of experts, who take part in the Development phase. This phase follows the design phase and the developers' main concern is to transform the Design Document into ready-to-use teaching materials.

Developers such as writers, graphic artists, and programmers are usually part of the *Training management team*. Sometimes the roles of designers and developers are played by the same people. In the case when a E-Learning based course should be developed, a high level of expertise in computer programming may be needed. In that case, the *Training management team* could assign the task to an outside organization, specialized in E-Learning systems development.

The Tutors are people directly involved in the training process. They are responsible for the successful achievement of the objectives of the training program and for the efficiency and effectiveness of the training process.

The role of the tutor is quite different from that of a classical teacher. Rather than being a 'content expert' who provides knowledge, the tutor is a facilitator, guiding and helping trainees to learn in appropriate manner. He/she is active and directive about the learning process to assure that the trainees stay on target.

The tutor's role requires some abilities and skills, relevant to the principles and practice of E-Learning: group dynamics, the use of learning resources and managerial skills.

In addition, the Training activities involve the following groups:

The Target population is a specific large group of employees within an organization which will be the subject of the planned training. The target population might also include people outside the organization, who are its potential employees.

The Target group is a small group (a sample) of people who are chosen from the target population to represent it. The target group is used to answer the questions and to give information about the target population, especially about its training needs and other characteristics, which are used by the *Training management team* and/or by *designers* and *developers*.

The Subject Matter Experts' population is a large group of professionals, who are experts in the particular area subject to training.

The Subject Matter Experts' group is a small group (a sample) of people who are chosen from the respective population to represent it. The role of this group is to help the *Training management team* to formulate the organization's requirements and standards related to the training.

8. Summary of the main features of the methodology

The evaluation of E-Learning systems should not be a separate phase in the development and implementation of the training. Rather, evaluation should be a **permanent process** for gathering and analyzing information throughout all of the phases.

The main objective of the evaluation is to provide reliable information for the quality, efficiency and effectiveness of the training program. This information should be used to improve the training program during the course development and implementation as well as after the end of the training program.

The evaluation of E-Learning systems should be performed taking into account **three main aspects** which are both complementary and interdependent:

- educational effectiveness and efficiency
- usability
- impact of the learning at the workplace after the training.

Finally, in order to build a high quality training program, the evaluation cycle should be **iterated** a couple of times (with different trainees), including all of the evaluation procedures, described bellow.

SECTION 2

Phases and Methods

9. Phases and relevant methods

As stressed in the preceding section, the methodology presented here covers the full cycle of training. In order to achieve this, one must have at their disposal a variety of methods and tests appropriate for each of the five deployment phases – analysis, design, development, implementation, and performance. The methods proposed in this guide are summarized in Table 1. In this Section, each method given in Table 1 will be described with respect to the information it can provide and how this information can be used in order to improve the E-Learning system. In Sections 3 and 4, detailed instruction of how to actually carry out the tests is given, and in Appendices A and B, additional material such as questionnaires, forms, etc. are provided.

Table 1. Phases and methods in the E-Learning deployment.

Type of evaluation	Phases				
	1. Analysis	**2. Design**	**3. Development**	**4. Implementation**	**5. Performance**
Educational efficiency	**Training needs analysis** *Method E1*: Survey of managers *Method E2*: Survey of experienced employees *Method E3*: Gap analysis	**Assessing learning styles and attitudes** *Method E4*: Kolb's Learning Style Inventory (LSI) *Method E5*: VARK *Method E6*: Attitudes to computer **Conceptual maps** *Method E7*: Free classification by experts		**Assessing learners' course satisfaction** *Method E8*: Tutor's diary *Method E9*: Happy sheets **Assessing learners' achievement - before and after the course** *Method E10*: Achievement tests *Method E7*: Free classification by learners	**Assessing performance** *Method E11*: Observation of the performer's work *Method E12*: Survey of key people
Usability Testing			*Method U1*: Heuristic Evaluation *Method U2*: User testing *Method U3*: Eye-tracking	*Method U2*: User testing *Method U4*: E-Learning user satisfaction questionnaire	

10. Analysis phase

10.1. Evaluation goals

Being the first step of the deployment of a training program, the activities in the Analysis phase (see Table 1) play a crucial role for the quality and optimality of the activities taken at the next stages. In this phase various measures are used, intended to specify the training needs of the organization and/or its departments. Based on the information gathered during this phase, decisions concerning the content and the specifics of the interface of the E-Learning system are made. These decisions are also essential from the efficiency point of view as the content can be limited to what is really required by the training task at hand. On the other hand, accounting for the personal characteristics of the future trainees (e.g. their learning style) allow for the tailoring of the E-Learning system to meet their personal preferences. The former includes the choice of areas of knowledge, skills, and attitudes and of particular topics and problems related to them which must be included in the core curriculum of the training.

The *Training needs analysis* is generally viewed as an assessment of the difference (the "gap") between what the trainees should know and what they actually know. Thus, in order to conduct it, one needs information about the organization's goals, requirements or expectations (performance standards, good practices etc.) and about the trainees' competencies before training.

10.2. Evaluation methods

The methodology comprises the following methods for performing the studies during the analysis phase.

10.2.1. Method E1: Survey of managers

The main purpose of the method is *to reveal the amount and the nature of the knowledge and skills needed by the future trainees.* The survey is intended to gather information on the target population, not on the managers, who just provide the information. The employees, who can be surveyed with a questionnaire, are heads (managers) of those units in which there are employees of the target population or in which such employees are expected to be employed in the near future. The managers could be at various management levels – first, middle, or line-managers. The only requirement for them is to be familiar in depth with the work tasks, performed by the people of the target population. These managers belong to the SMEs population.

Surveying managers, one should ask them about existing problems, difficulties and obstacles which the employees of the target population face in their everyday work and the typical mistakes they make. In other words, through the survey one would be able to assess indirectly the negative experience of the future trainees and the gaps in knowledge and skills necessary for achieving their working tasks.

The survey of managers could be used as a separate method for gathering information or in combination with method E2 Survey of experienced employees presented in the next subsection.

10.2.2. Method E2: Survey of experienced employees

The goal of this survey is *to reveal and gather the good practices* within the organization. In the context of E-Learning development, it is intended to gather

information about the target population (future trainees) rather than about the experienced employees.

The employees who should be surveyed are well-trained and experienced performers, who are expected to share their knowledge, skills and ideas for the purpose of the forthcoming training. The experienced performers could be viewed as a "model" to follow for the future trainees. They are also considered to belong to the SMEs population.

The survey should ask about their positive experience, good practices and should try to extract their recommendations about the content of the future training. In other words, through the survey one would like to observe indirectly the "good practical experience" of the future trainees. Furthermore, the key questions are about knowledge and skills, necessary to perform the working tasks successfully.

10.2.3. Method E3: Gap analysis

This analysis is based on Methods E1 and E2 (see subsections 10.2.1 and 10.2.2) and gives the evaluation of the difference between the *desired* or *necessary* level and the *actual* level of knowledge and skills, or performance of the trainees. The difference (or the "gap") between the current state and the necessary state will identify the needs, purposes, and objectives of the training.

These different sorts of information should be collected from two different sources: the people of the SMEs and of the target population. The role of the SMEs group is to formulate the requirements, usually in the form of the task inventory, consisting of all of the tasks, which the future trainees are required (or expected) to perform, and to set standards. The task inventory reflects the *desired* or *necessary* level of performance. The role of the target group is to express their *actual* level of proficiency at each task.

After gathering the information needed, one should compare the two kinds and on the basis of this comparison to take the final decisions.

11. Design phase

11.1. Evaluation goals

11.1.1. Learning style and attitude toward computers assessment

A learning style is a learner's preferred way of acquiring and processing of information in a learning environment. The learning style is considered to be a relatively stable personal characteristic. The choice of an appropriate presentation of the learning content can enhance the trainees' achievements, reduce the time, and increase the satisfaction from the training.

In the case of E-Learning, the attitude toward computers is another very important factor for successful training. This attitude can range from very positive to very negative depending on the age, education, and personal experience of the trainees. Many studies (e.g. Abouserie, Moss, & Barasi, 1992) demonstrate convincingly that individuals' positive or negative attitude towards computers is a reliable predictor of their acceptance of and learning achievements with E-Learning systems.

11.1.2. Assessing conceptual structures of experts and trainees

From the cognitive point of view, the main purpose of the training itself is to facilitate and to accelerate the process of acquisition of a set of concepts, which belong to a target knowledge domain. In many cases, before training learners have some preliminary knowledge about that target domain. In the Evaluation phase, one of the goals of testing is to make a comparison between the experts' knowledge as evidenced by their conceptual structures and the learners' conceptual structures before learning. The results provide information about how different the learners' conceptual structures are from the experts' and in what respect. On the one hand, this

information can be used to focus learning on the main misconceptions found thus making it more efficient and on the other, can be used to assess successful knowledge acquisition.

11.2. Evaluation methods

11.2.1. Method E4: KOLB's learning styles inventory

David Kolb's learning styles model is based on the Theory of experiential learning (Kolb, 1984; Kolb, 2005). The model defines four learning modes – Concrete experience (Experiencing), Reflective observation (Reflecting), Abstract conceptualization (Thinking) and Active experimentation (Doing). Kolb's Learning Style Inventory (LSI) is designed to identify an individual's way of learning. The instrument is a questionnaire in which respondents describe their learning preferences. Four learning styles are defined on the basis of the four learning modes mentioned above.

11.2.2. Method E5: VARK questionnaire

The VARK model states that one of the modalities of information acquisition (Visual, Aural, Read/Write, and Kinesthetic) is normally dominant and preferred by trainees (Fleming, 2001). This dominant style defines the best way for a person to learn new information. In other words, different training delivery methods are best suited for people with different modality preferences. For example, people that prefer auditory information, would benefit from auditory presentation of the material in a E-Learning system; people that prefer visual and pictorial information, would benefit from presentation of the information in a E-Learning system using diagrams and charts.

11.2.3. Method E6: Attitude to computers

Numerous instruments have been developed to assess this general construct. Some of them are the Computer attitude scale by Selwyn (1977), the Attitude scale by Collis (Collis and Williams 1987), the Computer attitude scale by Nash (1997), etc.

As people differ in their attitude to computers, a developer of a training program really needs to explore individual differences in that characteristic among the future trainees. It is reasonable to assume that people with positive attitude toward computers will be more successful in E-Learning than those with negative attitude. On the other hand, knowing the trainees' attitudes to computers allows designers to take them into account while developing a E-Learning and take advantage of it.

11.2.4. Method E7. Free classification

The method of free classification is a powerful tool for studying knowledge in the form of conceptual structures. The method allows the extraction of such structures from the semantic memory of trainees and experts. Moreover, the operational procedures of this method are simple, easy to understand and quite natural to carry out. The method could be applied for building a conceptual map of up to 100 concepts.

In the Design phase a free classification study with the participation of experts can generate a reference conceptual map which can be used to evaluate training achievements. The experts' conceptual map can also provide information to designers and developers about a possible structuring of the training content which will facilitate the formation of the right type of conceptual structure in trainees.

12. Development phase

12.1. Evaluation goals

In this phase the actual development of the E-Learning system takes place. There are two goals of the testing during this phase. First, to determine what the best software platform to implement the course is. Second, to test the actual implementation of the E-Learning system for compliance with the usability standards.

12.1.1. Decisions on the platform – prototype testing

During the Development phase, decisions about the exact methods and platform for delivering the course to the trainees should be made first. To this end, preliminary evaluation of different platforms should take place. This evaluation is based on comparing the features of platforms available with the general principles and standards (heuristics). Several prototypes of the course (built on different platforms) should be tested. Testing is performed using the Heuristic Evaluation checklist (see subsection 27).

12.1.2. Usability validation of the E-Learning modules

When the platform is chosen, the whole course is implemented on this platform. Here several usability tests are applied in order to ensure the usability of the E-Learning system.

12.2. Evaluation methods

In the Development phase, the methodology proposes three different methods that provide information concerning the E-Learning System usability.

12.2.1. Method U1: Heuristics 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.

12.2.2. Method U2: 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.

12.2.3. Method U3: Eye-tracking recordings

This method provides quantitative data on what elements of the E-Learning system interface users are looking at, for how long and in what sequence (Duchowski, 2003). Eye-tracking recordings give valuable information about the interaction of the user with the E-Learning system. This method is not frequently applied in usability studies because of its relatively high cost due to the specialized equipment and trained professionals required. However, the prices of eye-trackers are going down, making this powerful method more and more affordable. Eye-tracking studies could provide deeper recommendations on the design, layout and location of visual elements, menus, texts and graphics.

13. Implementation phase

13.1. Evaluation goals

13.1.1. Assessing learners' course satisfaction

Learners' course satisfaction is one of the significant markers of the quality of a training program. According to Kirkpatrick's 4-level training evaluation model, the first level is "Reaction of the trainees". It concerns how favorably the participants react to the training, how they felt, and what their personal reactions to the training or learning experience are. For instance, trainees are asked if they enjoyed the course or if they found it relevant to their needs.

Two data collecting methods and tools are proposed in the methodology – the Tutor's diary and the Happy sheets.

13.1.2. Assessing learners' achievement

Usually the test results (for instance the raw scores) serve to inform the learners and other interested parties on learners' achievement in a particular subject area. However, an individual score depends not only on a learner's capabilities and efforts, but also on the quality of the training program itself. This means one could explain the test results as an effect of the specific features of the training – its content, structure, delivery method, tutorship, etc. This is why the test procedures are one of the most reliable methods for evaluation of the efficiency and effectiveness of a training program.

13.1.3. Usability testing

During the implementation phase the usability testing should continue in order to study the usability of the E-Learning system in real training situations. Although usability tests have already been performed during the Development phase, during the Implementation phase of the course, more usability problems could be identified and fixed. In this phase the usability tests are performed with real users in their real study environment.

13.2. Evaluation methods

13.2.1. Method E8: Tutor's diary

The tutor is a person, involved actively in the training process. He/she has a close contact with the trainees and is the person to whom trainees address their questions when experiencing problems. The Tutor's diary represents a record made by the tutor about the trainees' questions, remarks, observations and recommendations during the course.

13.2.2. Method E9: Happy sheets

"Happy sheets" is a metaphor for the learning satisfaction questionnaire. This is one of the most frequently used methods for assessment of the trainees' opinion about the training. The questions cover the following topics:

- the content of the training program. This most important section of the questionnaire should include a list of topics covered in training, with check boxes for the trainees to indicate their level of understanding for each topic, such as "very clear", "clear", "a little confusing", "very confusing" and "not covered". The information gathered is very useful for redesigning the training.

- delivery methods
- trainer behavior and style
- facilities and course materials.

13.2.3. Method E10: Achievement tests (before and after the training)

Achievement tests are powerful instruments for assessing a learner's progress and final results in any subject area. Assessing by a test is considered as the most reliable and valid of all of the examination procedures. The achievement tests are standardized instruments, used to measure how much an individual has learned in relation to the educational objectives.

In order to estimate the progress (or "added value") of the trainees' knowledge and skills during the implementation of the training program, it is crucial to assess the trainees twice – at the beginning and at the end of the training course.

13.2.4. Method E7: Free classification with trainees (before and after the training)

In the Implementation phase, two studies with the trainees, using this method, are suggested:

1. Free classification study at the beginning of the course. The concepts structures derived reflect the trainees' knowledge at the beginning of the training.

2. Free classification study after the course. Now, the concepts structures reflect the trainees' knowledge at the end of the training.

Next, a comparison between the learners' conceptual structures before learning and after learning is carried on. The results provide information about the learners' added value of knowledge.

13.2.5. Method U2: User testing

The same method as the one described in section 12.2.2 is used. However, now the user testing is performed during the actual implementation of the course.

13.2.6. Method U4: 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.

14. Performance phase

14.1. Evaluation goals

14.1.1. Assessing performance

At this stage, it is studied how and to what extent the trainees transfer knowledge and skills, attained during the training program, to their places of work. Also subject to assessment will be the changes, the relevance of the changes and their sustainability.

According to Kirkpatrick's learning evaluation model, it is crucial to observe and evaluate behavior of the trainees after the training course is implemented. "Behavior" is the third level in Kirkpatrick's model ant it means the extent of applied learning back on the job.

The assessment of trainees' performance can be conducted at equal intervals after the end of the training program – e.g. 3, 6, and 9 months after the training.

It is appropriate to apply two assessment methods (separately or in combination): Observation of the performer's work and Survey of key people.

14.2. Evaluation methods

14.2.1. Method E11: Observation of the performer's work

Observations and interviews with the trainees are the most used methods to assess change, relevance of change, and sustainability of change as a result of the training. The work of the former trainees is observed and the data from the observations are filled in a checklist.

14.2.2. Method E12: Survey of key people

The way of gathering additional information could be in the form of an interview. The assessors can use the same check-list as the one used in Method E11 as a basis for the interviews. The target of the study is people who can assess the performance of the former trainees on their job – managers, experienced employees, etc.

SECTION 3

Toolkit

for Educational

Effectiveness of E-Learning

Systems

15. Method E1: Survey of line managers

15.1. General description

The main purpose of the method is *to reveal the size and the nature of the insufficiency of employees' knowledge, skills and attitudes.* Note that the survey is intended to gather information on the target population, not on the line-managers, who play the role of a data source. Surveying managers, they are asked about problems, difficulties and obstacles, which the employees from the target population face in their everyday work and the typical mistakes they make. In other words, through the survey we would like to observe indirectly the "bad experience" of the future trainees. Furthermore, the key questions are about knowledge and skills, necessary for implementing the working tasks successfully.

15.2. Tool

The survey is based on the questionnaire given in Appendix A.1. It is in the form of a structured interview, which is carried out "face-to-face" between interviewer and the respondent.

15.3. Participants

Employees who should be surveyed with the questionnaire are heads (line-managers) of those units in which there are recent recruits from the target population or in which such employees are expected to be hired in the near future. The number of managers to be interviewed should be about 10 – 20 people.

15.4. Procedure

The interview should be carried out with the agreement of the respondent. The interviewer should be well prepared for questioning and could take notes in the questionnaire paper or to record the respondent's answers using a tape-recorder.

In order to get consistent information from all of the respondents, the interviewer has to ask questions in the same sequence that they are presented in the booklet. On the other hand, after establishing a contact with the respondent, the interviewer is free to modify slightly the wordings (without any changes in their meaning) and to ask additional questions in order to make the respondent's answers more clear and comprehensive.

If the respondent is willing to fill in the form in writing, he/she could be allowed to, but in that case it is necessary to give the respondent preliminary general information about the purpose of the survey. The respondent (in both cases) should not be anonymous, e.g. he/she should fill in the demographic section of the questionnaire.

After interviewing all of the respondents planned, the questionnaires should be brought together and analyzed.

15.5. Results

Conducting the survey, the work of the employees from the target group will be seen from the point of view of their line-manages, who are the key persons in the working process. Performing the content analysis, the multitude of answers (line-manages' opinions) of the particular question (topic) will be reduced, organized and systematized in a way, which reveals and clarifies the structure and the relative weight of problem areas of interest. The most important of them are the difficulties and training needs of the members of the Target population.

16. Method E2: Survey of Experienced Employees

16.1. General description

First of all, the purpose of that kind of survey is *to reveal the good practices*, the positive effect on the quality of work. Note that the survey is intended to gather information on the target population (newcomers), not on the experienced people, who play the role of a data source. Surveying these people, they are asked about their experience, good practices and recommendation about future training. In other words, through the survey we would like to observe indirectly the "good experience" of the future trainees. Furthermore, the key questions are about knowledge and skills, necessary to implement the working tasks successfully.

16.2. Tool

The survey is based on the questionnaire (see Appendix A.2.), which consists of open-ended questions. It is developed as a structured interview, which is carried out "face-to-face" between interviewer and the respondent.

16.3. Participants

Employees, who should be surveyed with the questionnaire, should be well-trained and experienced people, who are expected to share their valuable knowledge and ideas about forthcoming training. The number of people to be interviewed should be about 10 – 20.

16.4. Procedure

The interview should be carried out with the agreement of the respondent. The interviewer should be well prepared for questioning and could take notes in the questionnaire paper or to record the respondent's answers using a tape-recorder.

In order to get consistent information from all of the respondents, the interviewer has to ask questions in the same sequence that they are presented in the booklet. On the other hand, after establishing a contact with the respondent, the interviewer is free to modify slightly the wordings (without any changes in their meaning) and to ask additional questions in order to make the respondent's answers more clear and comprehensive.

If the respondent is willing to fill in the form in writing, he/she could be allowed, but in that case it is necessary to give the respondent preliminary general information about the purpose of the survey. It is desirable that the respondent (in both cases) should not be anonymous, e.g. he/she should fill in the demographic section of the questionnaire.

After interviewing all of the respondents planned, the questionnaires should be brought together and analyzed.

16.5. Results

Conducting the survey, the work of the employees from the Target population will be seen from the point of view of their experienced colleagues. They will set up some kind of standards for successful performance of the job. Performing the content analysis, the multitude of answers (experienced employees' opinions) of the particular question (topic) will be reduced, organized and systematized in a way, which reveals and clarifies the structure and the relative weight of problem areas of interest. The most important of them are the good practices and training needs of the members of the target group.

17. Method E3: Gap Analysis

17.1. General description

The main objective of the method is to evaluate the difference between the d*esired* or *necessary* level of knowledge and skills and *actual* level of performance of the employee from the target group. The difference or the "gap" between the current state and the necessary state will identify the employees' and company's needs, purposes, and objectives.

17.2. Tool

The gap analysis is conducted by means of a questionnaire assessing desired and actual level of knowledge. This could also be done using a standardized test to measure the level of competencies and knowledge. The procedure for developing the tool is described in section 17.4

17.3. Participants

Participants are the two groups of employees. These are the Subject matter experts, on the one hand, and the employees from the Target group, on the other.

17.4. Procedure

17.4.1. Step 1. Task generation

This step is intended to generate a large number of task lists (Task inventories or Check-lists), associated with the training domain.

A task inventory consists of all tasks that an employee is required (or expected) to perform. It provides information about the skills, knowledge, and abilities required for effective using of the systems.

The task generation is implemented by the SMEs group. The aim of the group is to practically define the goals of the training – i.e. to determine these areas of knowledge and skills, which the employees from the Target population are expected to acquire. For this purpose the results from Method E1 and Method E2 could also be used.

Each SME should generate independently from others his/her own list of "tasks" – these are knowledge and skills, necessary for the employees to be successful in their jobs. Every item in the list should be a continuation of the statement "each employee must/should be able to…" with an action. SMEs should not be restricted with respect to the length of the list. They should be encouraged to generate as many as possible tasks (both concrete and general).

17.4.2. Step 2. Preparation of the final form of the Task inventory on the basis of individual tasks-lists generated

This step is implemented by the Analytical team, supported by the representatives of the SMEs group. Their goal is to merge all the individual lists generated at previous step and to make a single final Task inventory, which will serve to elaborate the content of the E-Learning program. Experience in such a procedure shows that the experts will come across the following features:

(1) It is very likely that each SME, based on his/her own point of view and/or experience will be able to describe only a part if the required tasks. That is why the final Task inventory would be longer than any individual list.

(2) It is very likely that different experts use more or less different wordings for the same tasks.

(3) It is very likely that the same tasks be suggested by different experts. So the task will differ in their frequency, which could be used as an indirect indicator of their importance.

After the lists are gathered together, the following steps are performed:

(1) The items should be classified into several large groups, corresponding to different areas.

(2) It is very likely that some of the items in each group are similar in meaning, but are different in wording. Therefore, the most appropriate wording should be chosen and "assigned" to the rest of similar items. In this way the seeming variety among answers will be reduced.

(3) Then, a name of each group should be given on the basis of the most frequent items and estimate their relative weight, for example, in percentage of all answers. This action will give a clear structure of the training needs.

An example is given in the following table.

TASKS	FREQUENCY
Task 1. ……	5
Task 2. ……	1
Task 3. ……	2
…….	…..
Task N. ……...	4

17.4.3. Step 3. Determination of the degree of necessity of each item (task)

This step should be implemented by all the experts in the SMEs group. They have to identify the desired or necessary level of implementation of each task for

organizational and personal success. This analysis focuses on the necessity of the tasks (requirements or standards) in terms of knowledge, skills and abilities needed to accomplish these tasks successfully. It is important that they should identify the critical tasks necessary, and not just observe the company's current practices. They also have to distinguish actual, real needs from their perceived needs or wants.

The evaluation should be made in a 10-point scale (where 1 = lowest degree of necessity and 10 = highest degree). Every SME should fill in the form separately. In this way about 20 grades for each item will be collected and will form a reliable basis for the further analysis of necessity.

It is advisable to identify every expert's judgements (name, position, unit etc.)

Here is an example of an individual Task inventory:

Subject matter expert……..….

TASKS	NECESSARY LEVEL OF IMPLEMENTATION (1 – 10)
Task 1. ……	5
Task 2. ……	10
Task 3. ……	8
…….	…..
Task N. ……...	3

17.4.4. Step 4. Employees mark their actual (current) degree of mastery (employees' self-assessment)

At this step the employees from the target group are given the same final Task inventory, used by SMEs at step 3. However, the employees perform a self-

assessment of their individual level of mastery. They use the same 10-point scale, where 1 = lowest degree and 10 = highest degree of mastery in corresponding task.

At this step every employee should also be identified (name, position, unit etc.)

Here is an example of an individual Task inventory, filled in by an individual employee from the target group:

Employee…….

TASKS	DEGREE OF MASTERY (1 – 10)
Task 1. ……	2
Task 2. ……	6
Task 3. ……	1
…….	…..
Task N. ……...	4

17.4.5. Step 5. Analysis: Examining the difference (the "gap") between the current and the necessary situation

The raw data collected consists of a great number of grades, given by SMEs and employees from the Target group. The data is entered into computer. The following statistics are calculated: means (averages) and standard deviations of the grades, given by experts for each item from the Task inventory. Means are considered as direct index of the necessity of different tasks.

The same statistics are calculated for the grades, given by employees for each item from the Task inventory. Means are considered as direct index of the mastery of the employees.

Data analysis is performed in terms of finding differences (or "distances") between every task's mean, "given" by experts (this is "the necessary situation") and employees (this is "the current situation"). The magnitude and the sign of the calculated values (the size of each "gap") are used as a direct indicator of the training needs of the employees from the target population in particular topic.

17.4.6. Step 6. Identifying priorities and importance (Examining the identified training needs in view of their importance to the company's organizational goals, realities, and constraints)

Up to the step 5 a relatively large list of needs for training intervention has been produced. Now these needs should be examined in view of their importance to the organizational goals, realities, and constraints. It must be determined if the identified needs are real, if they are worth addressing, and specified their *importance and urgency* in view of the organizational needs and requirements.

Participants in this step are again the SMEs (or part of their group). In order to assess the importance, the tasks in the inventory with magnitude of each need are arranged in descending order. It is quite possible to find in the bottom of the list a lot of tasks with small or zero magnitude of need. It is possible also for a part of the task (in the bottom) to be evaluated by experts as unimportant.

An appropriate method for evaluation of the importance of the tasks in the inventory is the so-called Delphi (or experts' judgment) method. Under this method every SME makes his/her independent judgment of the importance of each task. After that they share and discuss their opinions in a couple of meetings. The purpose of the meetings is to reach a mutual agreement about the (un)importance of each task.

17.4.7. Step 7. Making decisions

At this step the SMEs remove from Task inventory all the tasks evaluated as unimportant. In practice, they have to come to an agreement where the cut-off line

should be drawn. The cut-off (or threshold) line divides the descending ordered tasks into two groups – important and unimportant. Taking into account the evaluation of the training needs and the importance of each task (or group of tasks), the SMEs determine the priorities of the pending training program in view of their importance for the company's organizational goals, realities, and constraints.

There is no definite or strict order of submission of the three tools to the employees. They should be viewed as complementary sources of information. Nevertheless, it could be recommended to use the first two tools at the beginning. The information collected through them will be useful in making decisions after analyzing the results of the last questionnaire (Task inventory).

18. Method E4: Kolb's LSI

18.1. General description

One of the most popular learning theories, broadly applied in the field of HR and training, is the Experiential Learning Theory (ELT), launched by David Kolb (Kolb, 1984; Kolb, 2005; Kolb & Kolb, 2005). Kolb's learning theory sets out four distinct learning styles (or preferences). The learning style preference is actually the combination of two pairs of 'choices' that each individual makes, which could be presented as two orthogonal axes.

Active Experimentation (AE) ⇔ Reflective Observation (RO)

Concrete Experience (CE) ⇔ Abstract Conceptualization (AC)

On this basis Kolb defines four types of learning styles, each representing the unique combination of two modes:

- Diverging (Concrete Experience & Reflective Observation)
- Assimilating (Abstract Conceptualization &Reflective Observation)
- Converging (Abstract Conceptualization & Active Experimentation)
- Accommodating (Concrete Experience & Active Experimentation)

18.2. Tool

Kolb's Learning Style Inventory (LSI version 3) is designed to identify an individual's way of learning from experience and to measure the degree to which they display the different learning styles derived from the learning theory. The instrument is a 12-item questionnaire in which respondents describe their learning preferences.

Each item asks respondents to rank four sentence endings that correspond to the four learning modes – Concrete experience (Experiencing), Reflective observation (Reflecting), Abstract conceptualization (Thinking) and Active experimentation (Doing).

More information about the questionnaire is available at the following WEB-address: www.learningfromexperience.com. The questionnaire is available on-line and paper-based in many languages, including English and French. Payment conditions are stated on the site.

18.3. Participants

At least 30 trainees should fill in the questionnaire. If the test is administered in the design phase (as suggested in this guide), then the participants should be people who are representative of the target population.

18.4. Procedure

Each participant is working individually while filling in the questionnaire. The questionnaire could be administered in a paper-and-pencil or in a web-based version.

18.5. Results

After analysis of the data gathered via the questionnaire, participants are classified as belonging to following categories:

- *Divergers* (Concrete experience & Reflective observer). They take experiences and think deeply about them, thus diverging from a single experience to multiple possibilities in terms of what this might mean. They like to ask questions, and will start from details in order to construct the whole picture. They enjoy participating and working with other individuals and are generally influenced by them. They like to learn by

receiving logical instructions or actually doing a particular thing with conversations that lead to knowledge.

- *Convergers* (Abstract conceptualization/Active experimentation). They think about things and then try out their ideas to see if they work in practice. They like to understand how things work in practice. They like facts and will seek to make things efficient by making small and careful steps. They prefer to work by themselves, thinking carefully and acting independently. They learn through interaction and computer-based learning is more effective with them than other methods.
- *Accomodators* (Concrete experience /Active experimentation). They have the most hands-on approach, with a strong preference for doing rather than thinking. They like to ask 'what if?' and 'why not?' to support their action-oriented approach. They do not like routine activities and will take creative risks to see what happens. They like to explore the things by direct interaction and learn better by themselves than with other people. They like hands-on and practical learning rather than lectures.
- *Assimilators* (Abstract conceptualization/Reflective observation). They have the most cognitive approach, preferring to think than to act and like organized and structured understanding. They prefer lectures with demonstrations, and respect the knowledge of experts. They also learn through conversation that takes a logical and thoughtful approach. The best way to teach these people is with lectures that start from high-level concepts and work down to the detail.

Then, the design of the E-Learning learning should be in compliance with the most common learning style of the trainees in the target population.

19. Method E5: VARK questionnaire

19.1. General Description

Another tool that provides information about an individual's learning preferences is the VARK questionnaire (Fleming & Mills, 1992; Fleming, 2001). Learning preferences are viewed as ways that people take in and put out information in a learning context. Learners use all the modalities to receive information. However, one of these receiving sensors (or style) is normally dominant. This dominant style defines the best way for a person to learn new information by filtering what is to be learned. The VARK model considers four main modes of receiving information:

- Visual
- Aural
- Read/Write
- Kinesthetic

Actually VARK is an abbreviation of these four learning modes, namely Visual, Aural, Read/Write and Kinesthetic.

19.2. Tool

The corresponding VARK questionnaire consists of 13 multiple-point questions and was developed by Neil D. Fleming and Charles C. Bonwell (Fleming & Mills, 1992; Fleming, 2001). It should be noted, however, that the questionnaire is copyrighted material. More information on the VARK questionnaire is available at the following WEB-address: www.vark-learn.com.

19.3. Participants

At least 30 trainees should fill in the questionnaire. If the test is administered in the design phase (as suggested in this guide), then the participants should be people who are representative of the target population.

19.4. Procedure

Each participant is working individually while filling in the questionnaire. The questionnaire could be administered in a paper-and-pencil or in a web-based version.

The questionnaire is available on-line in many languages, including English and French. The user can download a printable *.pdf file. In each case, the user has to fulfill and submit an order form or copyright permission form.

19.5. Results

The VARK questionnaire allows the researcher to reveal the learning profile of an individual. According to the model, each individual prefers one of the learning styles and naturally falls into one of the following categories:

- *Visual*. These people like lecturers, who use gestures and picturesque language. If some textbooks are provided, they should contain diagrams, tables, graphs and simbols. The delivery method should include pictures, videos, posters, slides and other visual sources of information.
- *Aural*. People, who have a strong preference for learning by hearing, they actually prefer to attend traditional class-based learning. They take part in discussions and tutorials and like to discuss topics with the teacher and/or others. They like to share and explain their ideas to other people. They are capable to remember some interesting examples, stories and to describe

the slides, pictures and other diagrams to visuals to somebody who was absent.

- Read/Write. These people prefer to take in the information using lists, headings, dictionaries, glossaries, definitions, handouts, manuals and textbooks. They like to write out the words again and again, to read their notes, to rewrite the ideas and principles into other words. Usually they organize any diagrams and graphs into statements and turn reactions, actions, diagrams, charts and flows into words.
- Kinesthetic. These people prefer to to take in the information using all of the senses - sight, touch, taste, smell, hearing. The also prefer to work in laboratories and to take field trips. They like examples and applications of principles and lecturers who give real-life examples. They definitely prefer hands-on approaches (for instance computing) and apply trial and error approach.

As a result of the study, the individual's and group's dominant learning styles and profiles will be revealed. This would help mainly the designers and developers of the E-Learning system. Knowing trainees' learning styles will contribute to the improvement of the training programme mainly through improving the delivery methods. For example, if most of the trainees prefer Visual learning style, they generally prefer to take in the information from pictures, videos, posters slides, graph or flow charts. They like textbooks with diagrams and pictures. Therefore, the courseware should contain such kind of visual materials. In that case the trainees will have a better chance of success. At the same time any auditory supporting materials will be redundant.

20. Method E6: Attitudes to computer

20.1. General Description

An individual's attitude towards computers is a key component to understanding user's acceptance, learning success and satisfaction with computer-based training systems. As such, individuals' attitudes towards computers have been of interest to researchers in a variety of settings for sometime. Therefore, numerous instruments have been developed to assess this general construct.

Usually the items in such instruments are selected to measure the overall attitude by some sub-concepts such as stereotype, perceived control, perceived usefulness, computer anxiety, self-confidence, computer liking, behavioral and computer interest.

20.2. Tool

A lot of Computer attitude scales (CAS) were developed during past years, some of which were mentioned above. An example of a Computer attitude scale is presented in Appendix A.3. It was developed by M. Paprzycki (University of Texas) and D. Vidakovic (Duke University) (see Paprzycki et al., 1995).

The instrument is designed to assess how people react to using computers and computer-based training. The instrument is a 24-item Likert-scale questionnaire arranged on a 5-point scale from "Strongly agree" to "Strongly disagree". In addition to the study of the overall attitude toward computers, questions are combined into four groups representing particular areas of interest - the individuals' current feeling about computers; the perceived need for the computer (in the past, presently and in the future) and the perceived role of computers (in the present and in the future); the individuals' attitude toward E-learning.

20.3. Participants

At least 30 trainees should fill in the questionnaire. If the test is administered in the design phase (as suggested in this guide), then the participants should be people who are representative of the target population.

20.4. Procedure

The study is conducted before the training course, usually at the Design phase of the ISD. Proposed CAS instrument exists in paper-and-pencil form. In order to avoid the impact of the individual's attitude to computers, it is advisable to conduct the paper-and-pencil examination. Each employee receives his/her own copy of the instrument and answers the questions using the 5-point Likert-type scale.

20.5. Results

As a result, the individual's and group's profiles will be obtained. The higher the overall and factor's scores are, the more positive the attitude to the computers is. Once the developer or the E-Learning system reveals the individual's positive or negative attitudes, he/she could observe the relationship between the type of attitude and the results of the training (for example learners' satisfaction with the training or scores from achievement tests). If such kind of relation is proved, the developer could offer the employees with distinct negative attitudes to computers some alternative way of training, for example some kind of traditional classroom learning. Or the course should be made more fun, etc.

21. Method E7. Free classification

21.1. General description

The method of free classification is a powerful tool for studying the knowledge structures in a subject area as evidenced by the corresponding knowledge structures in the mind of experts and learners.

The present Methodology guide suggests conducting three free classification studies for obtaining three different conceptual maps for the same sample of concepts:

(1) Experts' conceptual maps;

(2) Conceptual maps of the trainees before learning;

(3) Conceptual maps of the same trainees after learning.

These revealed conceptual structures are the basic source for measuring value-added knowledge as a result of learning process. In order to do this assessment the following comparisons are possible:

(1) Comparison between the experts' conceptual structure and the learners' conceptual structures before learning. The results give information how far the learners' conceptual map is from the experts' one before learning.

(2) Comparison between the experts' conceptual structure and the learners' conceptual structures after learning. The results give information about improvement of the learners' conceptual map as a result of learning;

(3) Comparison between the learners' conceptual structures before learning and after learning. The results give information about the learners' added value of knowledge.

21.2. Tool

A list of concepts that are important and should be mastered during the training is used. The maximal number of concepts used in this method is 100 but optimal performance is achieved with 30 - 40 concepts.

The list is prepared using one of the following approaches:

- Independent (by each SME) generation of a list of concepts in the corresponding subject area and consensual selection of the final list;
- Content analysis of the learning textbooks and selection of the most important concepts related to the subject area and consensual selection of the final list;
- Combination of the two approaches.

21.3. Participants

To be able to use the method, a group of at least 20-30 people has to participate in the studies. The current methodology implies that the method should be used with 2 different groups of participants:

- participants from the SMEs group
- participants from the target group (trainees)

21.4. Procedure

The list of concepts is given to each participant for free classification, e.g. for grouping them with respect to similarity in meaning. Each participant is free to set up

as many groups of concepts and to put as many items into a single group as he/she wishes in his/her own opinion. The participants are also free to revise their initial judgments, to rearrange the content and the number of the groups up to the setting up of the final configuration. The general requirement is to put in the same group only those concepts, which are similar in their meaning.

There are two methods for performing the free classification task – computer-based performance and performance by hand.

In the computer-based performance the list of concepts is input into the program file and the participants carry out classification online following the correspondent directions. In the free classification carried out by hand the concepts are written on cards (one item on a single card). Numbers from 1 to *n* are written on the backsides of the cards (*n* corresponds to the number of to-be-classified concept).

21.5. Results

First, a similarity matrix of the concepts is obtained as an immediate result of the free classification task. The similarity between two items is proportional to the number of participants who have put them together. For instance, if 10 participants have put two concepts in one group, then the degree of similarity between the two concepts would be 10.

Next, two methods could be applied to analyze the similarity matrix obtained in free classification testing – hierarchical cluster analysis and multidimensional scaling. A hierarchical dendrogram is the product of the first method and a multidimensional configuration (space or "map") of the concepts is the result from the second one.

Both the dendrogram and multidimensional space represent the structure of concepts in the semantic memory.

The conceptual structure (or mental "map") obtained from the SMEs group should be regarded as a standard, pattern or norm because it is generated by experts. This is exactly what the training program aims at – to structure the trainees' knowledge in the

same way it is structured in the experts' minds. The experts' conceptual map becomes a standard which can be compared with the corresponding trainees' conceptual map at different moments in the training and give information about the progress achieved.

As a result of the comparisons, the following information is obtained:

- The difference between the experts' mental map and the trainees' mental map before the training provides information as to what the important topics that training should cover are.
- The similarities and differences of the trainees' mental maps before and after the course provide information about the changes in the conceptual structures as a result of training.
- The proximity between the experts' mental map and the trainees' mental map at the end of the learning is the basis for measuring of the efficiency of E-learning.

22. Method E8: Tutor's diary

22.1. General description

According to Donald Kirkpatrick's 4-level training evaluation model, the first (lowest) level is "Reaction of the trainees". It means how favourably the participants react to the training, how they felt, and what their personal reactions to the training or learning experience are. The evaluation of the first level is intended to answer the following questions. Did the trainees like and enjoy the training? Did they consider the training relevant? Was it a good use of their time? Did they like the teaching method, the tutor, venue, the style, timing, domestics, etc? What was the level of effort required to make the most of the learning? What was the perceived practicability and potential for applying the learning?

The tutor is a person, involved deeply in the training process. He/she leads a task-oriented group to successful achievement of the objectives of the training programme. In doing this, the tutor has to fulfill several responsibilities and is accountable to the training program for the satisfactory completion of them. These responsibilities require abilities and skills relevant to the principles and practice of E-learning, group dynamics, the use of learning resources and managerial skills.

The role of the tutor is quite different from the normal teacher's role. Rather than being a "content expert" who provides knowledge, the tutor is a facilitator, responsible for guiding trainees to identify the key issues in the content area and to find ways to learn those areas in appropriate manner. The tutor is not just a passive observer. He/she must be active and directive about the learning process to assure that the group stays on target. The tutor helps and advises the trainees, reacting and responding to all their needs.

22.2. Tool

Taking into consideration the grounds mentioned above, it is reasonable to ask tutor(s) to keep a diary in which to record the trainees' questions, remarks, observations and recommendation (one could say "reactions") during the course.

An example of tutor's diary sheet is given in Appendix A.4.

22.3. Participants

The main "actor" in this evaluation procedure is the tutor. Other participants are the learners during the training course.

22.4. Procedure

From the very beginning of the implementation of the training course the tutor(s) should take notes - not only the trainees' "reactions" (questions, remarks etc.), but also their names, the date and the topic (content), corresponding to the trainee's reaction.

The data collected will be processed at the end of the training course. An appropriate method for data processing is the analysis of the tutor's notes.

22.5. Results

As a result, one will have enough information on the reactions, attitudes and expectations of the trainees towards the training delivered. It will be known which the problem areas (topics) are about which the trainees have made notes, observations and recommendations. In the frame of each area more important and less important problems will be revealed. This information could be used to improve the training program at the next cycles of design, development and implementation of the E-Learning system.

23. Method E9: Happy sheets (learners' overall satisfaction evaluation form)

23.1. General description

"Happy sheets" is a metaphor for the learning satisfaction questionnaire. This is one of the most widely used methods for examining the trainees' opinion about the training. The focus is on the learner, not on the trainer. By means of such a questionnaire we wish to get valuable information from people, who are in the focus of the training efforts – the trainees. We also want to view the training process through their eyes, considering their opinion or overall satisfaction as first-hand information.

23.2. Tool

The content and the orientation of the questionnaire should be tailored to the specific content and purposes of the training program. This is why it cannot be compiled in advance, but after the development of the courseware. The questions usually are the Likert-type and open-ended and they should cover the following areas:

- content of the training program. This most important section of the questionnaire includes a list of topics covered in training, with check boxes for the trainees to indicate the level of understanding for each topic, such as "very clear", "clear", "a little confusing", "very confusing" and "not covered". Information gathered will be very useful in redesigning the instructional courseware and interface.
- delivery methods

- means (especially Computer assisted training)
- trainer behavior and style
- facilities
- course materials

23.3. Participants

The trainees themselves are the participants in the procedure.

23.4. Procedure

The Learners' satisfaction survey should be conducted immediately at the end of the training course. Each trainee has to receive and fill in a separate copy of the questionnaire.

23.5. Results

Both quantitative (for Likert-type questions) and qualitative (for open-ended questions) methods of data processing should be applied.

For all of the Likert-type questions the mean value and the standard deviation should be calculated. The mean is considered as an indicator of the trainees' opinion of the corresponding characteristic of the training program. Questions should be arranged by their means in order to obtain the degree of trainees' satisfaction of corresponding characteristic.

This analysis provides information about the quality of the learning program, viewed through the eyes of the trainees. This information is useful not only to assess the trainees' satisfaction, but also to improve the training program at the next cycles of design, development and implementation of the E-Learning system.

24. Method E10: Achievement tests

24.1. General description

Achievement tests are powerful instruments for assessing learner's progress in any subject area. Assessing by test is considered the most reliable and valid among all of the examination procedures. One could find a plethora of definitions what the achievement tests are. They are usually described as educational instruments, typically standardized and norm referenced, used to measure how much an individual has learned in relation to educational objectives. Another view is that they are supposed to measure how much an individual has learned, not what he/she is capable of learning. They are given after the individual has been instructed in a particular area of knowledge or trained in a specific set of skills.

The common elements of the multitude of definitions are that the achievement tests:

- are designed to assess a learner's knowledge and skills in a specific area;
- are usually given at the end of an instructional course.

Usually the test results (raw test score) serve to inform the learners about their achievement in a particular subject area. Nevertheless, an individual score depends not only on the learner's efforts, but also on the quality of the training program itself. This means one could explain the test results as an effect of the specific features of the training – its content, structure, delivery method, tutorship etc. This is why the test procedures are one of the most reliable methods for evaluation of the effectiveness of a training program. The effectiveness could be seen as development or increasing of those competencies (knowledge and skills), which have been stated as programme

objectives. The growth of competencies is as considerable and significant (in statistical sense) as the training is effective.

In order to estimate the progress (or the "growth" or "added value") of the trainees' knowledge and skills during the implementation of the training program, it is crucial to assess the trainees at least twice - at the beginning and at the end of the training course.

24.2. Tools

24.2.1. Pre-test instrument

The purpose of the preliminary test is to assess the entrance level of the trainees, e.g. to examine what the level of trainees' competencies is at the beginning of the training. An additional effect of the pre-testing will be determination of the homogeneity of the group of trainees and the opportunity to set up more than one subgroup which could be trained in different teaching "pathways".

An achievement pre-test should be developed to assess both knowledge and skills. Therefore it should consist of two sections: (1) for assessing knowledge and (2) for assessing skills (performance section).

Each section should consist of at least 20 items.

The first one should be oriented to the facts, notions, and concepts etc., related to the content of the training program. The items could be in multiple-choice format.

The second one should be presented in the form of tasks (e.g. can-do items), in which the trainees will perform different tasks, identical to the ones they should perform at the end of the training program.

It is reasonable for the achievement pre-test to be a shortened variant of the final (post-training) examination test.

24.2.2. Formative tests (for each part of the course, if applicable)

Usually a training course is naturally divided into a number of modules, which are relatively separate and independent parts of the training program. In that case it is possible to perform so called “formative assessment”.

The formative tests are designed to assess the trainees’ progress during the training. The content of each module should be covered by a corresponding formative test, which is taken at the end of that module. The content and the structure of each formative test should reflect the content, the structure and the aims of the corresponding module.

The minimum required number of items in a formative test is 20 items.

24.2.3. Summative (final) post-test

An achievement post-test should be developed to assess the overall proficiency (in terms of both knowledge and skills), attained by the trainees during the implemented training program. Therefore, it also should consist of two sections: (1) for assessing knowledge and (2) for assessing skills (performance section).

Each section should consist of at least 20 items.

The first one should be oriented to the facts, notions, and concepts etc., related to the overall content of the training program. The items could be in multiple-choice format.

The second one should be presented in the form of tasks (e.g. can-do test), in which the trainees will perform different tasks, identical to the ones they should perform at their working places.

All of the achievement tests should be criterion-referenced, which means that an individual achievement (expressed for instance in test score) should be compared with the outer “criterion”, which is the content of the (respective part of the) training

program. In order to assess the examinee's result (e.g. "pass" or "fail", it is necessary to set a cut-off border line (or acceptable low boundary of achievement), which is usually set at 70% of the total raw score.

24.3. Participants

Participants are 20-30 trainees that undergo the learning program. The same group of participants performs the two tests – before and after training.

24.4. Procedure

There are two options to perform the achievement test procedure: (1) Each test (pre-test, formative and summative) could be developed as a Computer-based assessment tool and could be integrated in the E-Learning system modules. Another option is to be printed (as a hard-copy). In the second case every trainee will receive his/her own booklet. Answers will be marked on separate answer-sheets as follow:

- answers to the knowledge (multiple-choice) items – by the examinee
- answers to the skills (can-do) items – by the tutor (assessor)

All of the answers will be scored 1/0 (correct or wrong).

24.4.1. Data processing

First, two results are obtained:

- The examinees' raw score. The score represents the total number of correct answers for each examinee. Then the percentage of achievement will be calculated, dividing the examinee's raw score by the total number of items in the test. This will be used as a measure of the examinee's achievement.

- Item and test statistics. One of them is a set of common item statistics such as difficulty and discrimination index. Since each item represents a separate "unit" of knowledge or skills, the difficulty parameter is used as a direct indicator of which are the weak and strong points of the training process in terms of trainees' competencies. This information could be used to improve the training program at the next cycles of design, development and implementation (see the table above).

Another group of statistics describes the test as a whole. They are useful for improving the test itself. Another function (for example, of the Mean percentage of implementation) is to assess the achievement of the trainees as a group, e.g. to evaluate to what extent they have acquired knowledge and skills required (the content of the training program). Such statistics could also be used as an overall indicator of the success of the training.

Additionally the more complex statistical techniques will be applied (such as ANOVA, Factor analysis) in order to reveal the relations between trainees' achievement and some independent variables as gender, age, learning style, attitudes toward computers, course satisfaction etc.

24.5. Results

Results from the testing procedures could be viewed from two perspectives.

On the one hand, these are the trainees' tests scores before and after the training. The individual's scores and group's mean scores reveal the level of the individual's and group's competencies in a particular subject area before and after the training. The magnitude of the difference between them, which could be assessed by ANOVA design, will be used as an overall measure of the effectiveness of the training program.

On the other hand, these are the item's and test's statistics such as difficulty and discriminative indexes and mean percentage. They will reveal which particular

topic(s) of the training content have been mastered better and which – worse. These data have to be used in the next cycles of ISD model to improve the content, the curriculum, the design and development of the E-Learning system.

25. Method E11: Observation of the performer's work

25.1. General description

According to D. Kirkpatrick's four-level learning evaluation model, it is crucial to observe and evaluate behavior of the trainees after the training course is implemented. "Behavior" is the third level in Kirkpatrick's model and it means the extent of applied learning back on the job (implementation) or how the trainees successfully transfer the acquired knowledge and skill in their everyday working efforts.

Observation and interview over time are the most widely used methods for the assessment of change, relevance of change, and sustainability of change.

25.2. Tool

In the framework of the method, a check-list is first prepared, in which should be included the most important can-do tasks, used in the summative (final) post-test. These items should be written in the form of declarative statements, for instance "The performer displays chart of accounts", "The performer runs the balance sheet", "The performer maintains the financial statement version" etc. The observer uses a simple and widely used reporting 6-grade rating scale.

25.3. Participants

The participants are the former trainees (at present "performers"). They are the subject of observation and evaluation. Their number should be not less than 20.

The observation should be assigned to the members of the Subject matter experts (SMEs) group (about 3 – 5 members), who play the role of assessors in this case.

25.4. Procedure

Observations should be conducted at the performer's place of work at an appropriate time, negotiated between the performer and the assessor. The observation lasts long enough for the assessor to get sufficient impressions of the performer's work. The observer has no rights to disturb the performer, to ask questions or to intervene in his/her work. The assessor is allowed only to act as an observer and to take notices on the performer's work.

After observing the performer's work, the assessor summarizes his/her impressions, using a 5-grade rating scale. Commonly, the five options are: "excellent", "very good", "good", "satisfactory" and "poor". Besides their verbal labels, the points of the scale have their numerical values, usually from 5 ("excellent") to 1 ("poor ").

As a general rule, one performer has to be assessed by one observer.

In order to assess the sustainability of the employee's application of what has been learnt, it is necessary to observe the employee's "behavior" or performance on the job at least three times. For example:

- three months after the end of the course;
- six months after the end of the course;
- and nine months after the end of the course.

In order to gather consistent information, the assessors should use the same check-list at every stage of observation.

25.5. Results

After gathering the information, the performance of each employee will be analyzed separately and the performance of the performers' group as a whole as well.

For example one could firstly review what the assessor's grades of each particular task are for each trainee. Similar analysis could be performed in order to assess the "behavior" of the group of performers as a whole.

The tasks could be arranged in decreasing order to reveal what the more successful implementations and what the less successful are.

After that, the overall performance level of the tasks will be assessed by calculating the mean (average) value of all assessors' grades. The mean statistic will be considered as a direct valuation of the employee's "behavior" at work. One can compare the three "behavioral" mean statistics (3, 6 and 9 month after the training). It will display if there are any changes, the type of the changes and their direction.

26. Method E12: Survey of key people

26.1. General description

Observation of the performer's work (Method E11) is a very useful method but it is quite possible that one or another employee will not perform all of the tasks, included in the check-list. It depends on the type of work performed by the employee at the time of observation. In such a case, the observer should observe the performer's work for a long time.

In case of insufficient, unreliable or suspicious-looking information on some of the topics, included in the check-list, it will be necessary to ask some key people for additional information about the performer's work.

So the method of surveying key people could be considered as a complementing way for gathering additional information or it could be conducted as a second independent means.

26.2. Tool

The way of gathering additional information could be in the form of interview. Also, the assessors are free to use the same check-list used in Method E11, both asking particular questions about topics about which there is a shortage of information or using the whole check-list as an independent tool.

26.3. Participants

"Key people" or interviewees in this case are usually the line-managers of the performer or his/her colleagues, who are well experienced and familiar with the performer's work.

26.4. Procedure

The interviews with key people should be conducted at their place of work at an appropriate time, negotiated between the two participants. The assessor is free to ask any question concerning the particular employee's performance.

After conducting the interview, the assessor summarizes his/her impressions, using a 5-point rating scale. Commonly, the five options are: "excellent", "very good", "good", "satisfactory" and "poor". Besides their verbal labels, the points of the scale have their numerical values, usually from 5 ("excellent") to 1 ("poor ").

As a general rule, one performer has to be assessed by one assessor through the information gathered from one or a couple of key people.

In order to assess the sustainability of the employee's application of learning, it is necessary to observe the employee's "behavior" or performance on the job at least three times. For example:

- three months after the end of the course;
- six months after the end of the course;
- and nine months after the end of the course.

In order to gather consistent information, the assessors should ask the same questions or to use the same check-list at every stage of observation.

26.5. Results

After gathering the information, the performance of each employee will be analyzed separately and the performance of the performers' group as a whole as well.

Using this method one obtains information about the practical value of the training.

SECTION 4

Toolkit

for Usability Evaluation

of E-Learning Systems

27. Method U1: Heuristic evaluation

27.1. 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 (4-7) 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.

27.2. 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 in the usability checklist developed by the Usability Lab at CEE Center for Cognitive Science, NBU.

A. System design

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

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.

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 simple and unambiguous.

The complete checklist for Heuristic evaluation of E-Learning system developed by the Usability Lab at Center for Cognitive Science, NBU is presented in Appendix B.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

27.3. Participants

Heuristic evaluation is performed by 4-6 trained experts without trainees' involvement.

27.4. Procedure

27.4.1. Preparation of the Heuristic Evaluation materials

Heuristic evaluation checklist is made in an electronic form as an Excel table. Simple heuristics are organized into groups according to the general usability principles. For each heuristic, the following fields are present:

- field in which the presence or absence of an usability problem is identified
- field in which the actual location of the identified problem is described
- field for severity rating of the problem found
- field for recommendations or how to overcome the problem
- field for comments and broader description (if needed) of the problem

27.4.2. 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 (see section B.1.1. in Appendix B).

27.4.3. Conducting the heuristic evaluation

Evaluation is performed by 4-7 trained experts. Evaluators should be usability specialists.

Each individual expert evaluates the system alone. It is important to keep this procedure as it ensures independent and unbiased evaluation from each expert. The

Heuristic Evaluation session for each evaluator lasts two hours. For larger and complex E-Learning systems more time is needed. In such a case it is better to split up the evaluation is several such sessions, each concentrating on a part of the interface.

The system is tested with respect to the checklist prepared (the checklist is presented in section B.1.2. in Appendix B). 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. If needed, additional comments should be written. 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, separate row for every instance is filled in the table.

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.

27.4.4. 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.

27.5. 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

A final report should have the following form:

Problem 1

- Description and analysis
  - Detailed description of the problem, including the element or part of the system where it is found. A screenshot is included when appropriate. Description of which usability heuristic is violated. Analysis of the consequences if the problem persists.
- Severity
  - Severity of the problem of the problem based on the importance ratings. Recommendations on the effort that should be allocated at resolving the problem.
- Recommendations
  - Recommendations and proposal for resolving the problem.

Problem 2

- Description and analysis
  - …….
- Severity
  - …….
- Recommendations
  - ……

28. Method U2: User Testing

28.1. 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.

28.2. Tool

28.2.1. 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

28.2.2. 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

28.2.3. 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

An example worksheet is presented here:

Task ……..…. Start time …….

Accomplished yes/no End time …….

Actions	User's comments	Observer's comments
Action 1		
Action 2		
Action 3		
…..		

28.3. Participants

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

28.4. Procedure

The User Testing is performed in the following steps:

- training of the experts
- conducting the user testing
- analysis
- final report

28.4.1. 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.

28.4.2. 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 (see section B.2.1. in Appendix B) 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.

28.5. 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.

29. Method U3: Eye-tracking recordings

29.1. General description

In eye-tracking recordings the participants gaze is recorded. Next it is superimposed on the interface of the E-Learning system the participant is interacting with. In the most of the modern eye-tracking systems the eye is illuminated with infrared light and the point of gaze is computed by the relative position of the pupil and the reflection of the cornea. Eye tracking systems can be mounted on the head or may be remote. Remote eye-tracking systems consist of a camera and an infrared source mounted next to the computer monitor. Remote eye-tracking systems are more suitable for usability research of E-Learning systems as they provide more natural and comfortable settings for the learners being tested (Jacob & Karn, 2003).

People see clearly only in the central area of the visual field. High visual acuity is present only in the fovea. Visual acuity declines steadily from the fovea to the periphery. In order to cover larger visual areas and to get detailed information eye movements are needed (Palmer, 1999; Rayner, 1998).

Therefore, the study of eye-moments during working with the E-Learning system can tell us what information subject is looking at and for how long gaze remains on a specific part of the learning environment. Analysis of eye-movement data can tell us which elements of the display or of the text are important for the learners; where they encounter difficulties; what are the usual patterns of scanning or reading the material. Such information is valuable in testing the interaction of the learner with the E-Learning system. It provides insight on what is the pattern of reading the material; what parts are important; what are the difficulties users are experiencing.

29.2. Participants

At least 8–10 trainees should participate in the eye-tracking study in order to get data suitable for subsequent statistical analysis.

29.3. Procedure

The Eye-tracking study requires implementation of the following steps:

- specifying the measures that should be used
- specifying the tasks to be used in the testing
- conducting the testing
- analysis
- final report

29.3.1. Specifying the measures that should be used

In the first step of the Eye-tracking study one must choose some aspects of eye movements (dependent variables or metrics) to analyze. A variety of such metrics exist - position, duration, count, frequency and sequence of fixations are used to study different tasks. Some of the most widely used metrics are briefly presented in Table 2. (Jacob & Karn, 2003). In their description the term AOI has to be introduced: *area of interest* (AOI) is defined as a part of the display that is of interest to the researcher.

Metrics	Interpretation
number of fixations (overall)	task difficulty search efficiency
number of fixations (on each AOI)	importance of / interest in that AOI
proportion of time on each AOI	importance of that AOI, difficulties in extracting information
scan paths (sequence of fixations)	search path pattern of processing information
transitions between AOI	consecutive attention (comparison)
fixation duration	decoding difficulty level of processing

Table 2. Commonly used metrics in the eye-tracking studies.

29.3.2. Specifying the tasks to be used in the testing

Before conducting the study tasks that learners will perform should be identified. The tasks should be representative for the usage of the E-Learning system. Usually most important and frequently used tasks are included.

29.3.3. Conducting the testing

The eye-tracking studies are performed using 5 – 10 learners. In the beginning of the testing the eye-tracking equipment is calibrated. Normally the test with one participant (after the calibration) should not last more that 20 minutes in order to obtain quality data.

In order subjects to feel comfortable, the eye-tracking equipment with remote optics is preferred. In such settings the user is sitting comfortably in front of the computer screen while the eye-tracking device is place near the monitor.

Eye-movement data are recorded and superimposed on the screen image by the means of specialized software. The software records also mouse movements and clicks and the interactive change of the E-Learning system display.

29.4. Results

29.4.1. Analysis

Analysis of eye-movement data is performed in several aspects. First aspect of analysis is concerned with the typical scan paths performed. Another aspect of analysis is related to AOIs (areas of interest) defined on the interface. For each such area several metrics are obtained:

- number of fixation in the AOI
- percent of fixations in that AOI
- time spent looking in the particular AOI
- percentage of time spent looking in the AOI

Analysis of the eye-tracking data could give information which objects (text, graphics and so on) attract more attention. We could also tell what the first objects that participants look at are. Analysis also reveals which elements remain unattended and learners rarely look at them. We could also gain insight on how efficient the work and search within the E-Learning system interface is.

29.4.2. Final report

In the final report of eye-tracking study the typical usage of the E-Learning system is summarized and presented. Main findings and problems are described. Recommendations of improvement of the system are offered.

30. Method U4: User Satisfaction Questionnaires

30.1. 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

30.2. Tool

30.2.1. 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. The questionnaire developed is presented in section B.4.1. in Appendix B.

30.2.2. 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.

30.3. 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.

30.4. Procedure

Procedure for conducting the study should follow the following steps:

- Design of the questionnaire
- Preparation of the test material
- Conducting the test
- Analyzing the data

- Making recommendations on the system

30.4.1. 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).

30.5. Results

30.5.1. 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.

30.5.2. 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 A

A.1. Method E1: Survey of line-managers questionnaire

(DESTINÉ AUX CHEFS DE SECTIONS. LES QUESTIONS SONT LIÉES À LA SECTION EN TANT QU'UNITÉ)

Nom de l'interviewé:
Fonction:
Position:
Section:
Date de l'interview:
Ayant fait l'interview:

1. L'accomplissement de quelles tâches de travail de la section est lié directement à l'utilisation de systèmes électroniques d'information et de communication (SEIC) de la compagnie Turbomeca (Intranet, SIG, GEODE, Disque T etc.)?

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.....

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2. Y a-t-il des exigences formelles envers les employés nouvellement embauchés pour faire des efforts afin de maîtriser les SEIC de la compagnie?

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.....

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3. Lesquels des SEIC sont utilisés par les employés de la section que vous dirigez?

.....

.....

.....

- Pourriez-vous les ranger selon l'intensité (la fréquence) de leur utilisation?

.....

.....

.....

4. Les employés de la section utilisent-ils d'autres sources d'information et de communication (différents des SEIC)? Lesquelles?

.....

.....

.....

.....

S'ils en utilisent, quel groupe de sources est leur préféré?

.....

.....

.....

5. Pensez-vous que le manque d'aptitudes pour l'utilisation de SEIC mène à un pire accomplissement des obligations professionnelles des employés?

.....

.....

.....

6. Selon quels critères jugez-vous qu'il existe un lien direct entre l'utilisation de SEIC et la qualité du travail ou considérez-vous qu'un tel lien n'existe pas?

.....

.....

.....

7. Quels employés utilisent de manière plus intensive les possibilités, offertes par les SEIC – les anciens ou les nouvellement embauchés?

.....

.....

.....

8. Laquelle des deux catégories d'employés se heurte plus souvent à des difficultés considérables?

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.....

.....

9. Quelles sont les difficultés les plus fréquentes devant les employés qui utilisent les SEIC? Quelles sont les erreurs typiques qu'ils commettent?

.....

.....

.....

.....

10. Comment les employés compensent-ils le déficit d'aptitudes dans l'utilisation des SEIC?

.....

.....

.....

11. Quelles sont leurs stratégies pour l'acquisition de maîtrise des SEIC?

(AUTO-FORMATION D'APRES LA METHODE ESSAI/ERREUR, RECHERCHE D'AIDE DES EMPLOYES PLUS EXPERIMENTES, ETC.)

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.....

.....

12. La section (la compagnie) a-t-elle aidé ses employés pour l'utilisation des SEIC par quelque sorte de formation?

.....

.....

.....

- Si la réponse est positive quelle est votre évaluation générale de la formation effectuée jusqu'à présent pour vous personnellement et pour les employés de votre section? Quels en sont les avantages et les problèmes principaux?

.....

.....

.....

.....

13. Pensez-vous qu'il serait utile pour la qualité du travail de vos employés s'ils passaient une formation (supplémentaire) dans l'utilisation des SEIC de la compagnie? Justifiez votre opinion, s.v.p.

.....

.....

.....

.....

(si la réponse est positive, continuez avec les sous-questions suivantes)

- Auquel des SEIC existants faut-il prêter davantage d'attention? Prière de les ranger par priorité

1. .....

2. .....

3. .....

4. .....

5. .....

- Quelles connaissances et aptitudes (qualification supplémentaire) devraient obtenir les employés lors de cette formation? Prière de ranger ce qui est le plus important selon vous

.....

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.....

- Laquelle, selon vous, est la forme la plus appropriée de la formation (année sabbatique, enseignement assisté par ordinateur, classique etc.)

.....

.....

.....

- Quel, d'après vous, est l'endroit le plus convenable pour l'accomplissement de la formation? (au lieu du travail au TM, dans un centre de formation / de conférence, etc.)

.....

.....

.....

- Quelle devrait être la durée de la formation? (une journée, une semaine; une formation plus longue ou quelques séances plus courtes)

.....

.....

.....

Nous vous remercions de votre participation et des opinions partagées!

A.2. Method E2: Survey of experienced employees questionnaire

(QUESTIONNAIRE PERSONNEL, DESTINÉS AUX EMPLOYÉS DE LONGUE EXPÉRIENCE, Y COMPRIS LES CHEFS DE SECTION)

Nom de l'interviewé:
Fonction:
Position:
Section:
Date de l'interview:
Ayant fait l'interview:

1. L'accomplissement de quelles tâches de travail est lié à l'utilisation des systèmes électroniques d'information et de communication (SEIC) de la compagnie?

.....

.....

2. Lesquels des SEIC utilisez-vous lors de l'accomplissement de vos engagements professionnels?

.....

.....

- **POURRIEZ-VOUS LES RANGER SELON L'INTENSITE (LA FREQUENCE) DE L'UTILISATION?**

.....

.....

3. Pourriez-vous raconter quelle est l'expérience positive acquise par vous dans l'utilisation des SEIC? Quels types de tâches accomplissez-vous mieux grâce aux possibilités offertes par les SEIC? Prière de donner quelques exemples concrets.

.....

.....

4. Rencontrez-vous des difficultés lors de l'utilisation des SEIC?

(si la réponse est positive, posez les questions sur les détails)

- **POURRIEZ-VOUS INDIQUER DES PROBLEMES CONCRETS, LIES A L'UTILISATION DES SEIC ?**

.....

.....

- **DE QUELLE MANIERE CES DIFFICULTES INFLUENCENT L'ACCOMPLISSEMENT DE VOS TACHES PROFESSIONNELLES?**

.....

.....

.....

- **VOUS PERSONNELLEMENT, SUR QUOI COMPTIEZ-VOUS POUR AUGMENTER VOS APTITUDES DANS L'UTILISATION DES SEIC?**

(PRIERE DE RANGER LES PRIORITES EN INSCRIVANT DANS LES CASES LES NOMBRES DE 1 A 4)

- ☐ Sur l'auto-formation.
- ☐ Sur l'aide et sur les conseils des collègues, du chef de la section
- ☐ Sur les consultations des experts de TM qui sont responsables des SEIC

- ☐ Sur une formation, organisée par la compagnie

Autres.....

.....

.....

5. D'après vous, les nouveaux employés de la compagnie utilisent-ils de manière suffisamment efficace les possibilités offertes par les SEIC?

.....

.....

- **SI VOTRE REPONSE EST NEGATIVE, QUELLE EN EST LA RAISON?**

.....

.....

6. Pensez-vous que les nouveaux employés ont besoin d'une mise a niveau supplémentaire dans le domaine des SEIC par un programme de formation?

(si la réponse est positive, passez aux sous-questions)

- Quelle devrait etre l'orientation de la formation pour que les nouveaux employés puissent accomplir leurs obligations professionnelles plus efficacement en utilisant des SEIC?
- **PRIERE D'INDIQUER CERTAINES CONNAISSANCES ET APTITUDES CONCRETES QU'ILS DEVRONT OBLIGATOIREMENT ACQUERIR.**

.....

.....

10. Vous personnellement, prendriez-vous part à une telle formation?

.....

.....

- **SI VOTRE REPONSE EST POSITIVE, QUELLES SONT LES TROIS CHOSES LES PLUS IMPORTANTES QUE VOUS VOUDRIEZ APPRENDRE?**

.....

.....

11. Y a-t-il une chose que vous aimeriez partager en liaison avec l'utilisation des SEIC lors de l'accomplissement de vos obligations professionnelles sur laquelle nous n'avons pas posé des questions jusqu'ici?

.....

.....

Nous vous remercions de votre participation et des opinions partagées!

A.3. Method E3: Attitudes to computers

A.3.1. Attitudes to computers questionnaire

ATTITUDES TOWARD COMPUTERS SCALE

INSTRUCTION: *Indicate the extent to which you agree or disagree with the statements listed below. Be sure to respond to every statement. Respond to each statement on a five-point scale: strongly agree, agree, undecided, disagree, and strongly disagree.*

The response is made by putting X in the corresponding cell.

		strongly agree	agree	undecided	disagree	strongly disagree
1	I am frustrated by computers.					
2	My experience in working with computers is negative.					
3	Many times in the past when I needed to use a computer but I didn't know how to do it.					
4	I feel uncomfortable each time I start to work with computers.					
5	I will use the computer after the E-learning training course.					
6	Only smart people use computers.					
7	I think that I will be never be successful working with computers.					
8	I am afraid that one day computers will take over and enslave people.					
9	I think that computers do not save me time.					
10	One cannot learn about computers by her/himself.					

		strongly agree	agree	undecided	disagree	strongly disagree
11	I am interested in learning more about computers.					
12	E-learning courses should be a requirement for all my colleagues.					
13	Sufficient instructions should be provided when using computers.					
14	This E-learning course will make me appreciate the use of computers in my field.					
15	I am always ready to learn new things.					
16	I feel uncomfortable when I see that other trainees know more about computers than I do.					
17	I think that the computer is a tool that I will never need to use.					
18	This E-learning course will help me in other courses where computers are used.					
19	This E-learning course will have a big impact on my performance when I back to work.					
20	Using computers should be a part of all training programmes.					
21	One can get addicted to the computer just as one can get addicted to drugs.					
22	I expect to use computers much more than I have before.					
23	Taking this E-learning course will help me overcome my frustration with computers.					
24	I think that the role of computers in daily life will increase in the next ten years.					

A.3.2. Results scoring

To obtain measures of trainees' attitudes toward computers, use a simple and widely used self-report method known as Likert scale (Grounlund, 1981). A list of favorable or unfavorable attitude statements are presented and trainees are asked to respond to each statement on a five-point scale: strongly agree, agree, undecided, disagree, and strongly disagree. The scoring of a Likert-type scale is based on assigning weights from 1 to 5 for each position on the scale. Favorable statements are weighted 5, 4, 3, 2, 1 (from strongly agree to strongly disagree). Unfavorable statements have these weights in reverse order. Questions 1, 2, 4, 6, 7, 8, 9, 10, 16, 17, and 21 in the survey are considered as unfavorable and are treated according to the above description.

In addition to the study of the overall attitude toward computers, questions are combined into four groups representing particular areas of interest. Questions 1, 2, 4, 6, 7, 8, 9, 16 and 21 characterize the individuals' current feeling about computers. Questions 3, 5, 17, 20, 22 and 24 assess the perceived need for the computer (in the past, presently and in the future) and the perceived role of computers (in the present and in the future). Questions 10, 11, 13 and 15 address the individuals' attitude toward learning. Questions 12, 14, 19 and 23 deal with the attitude toward the Computer assisted learning itself.

A.4. Method E8: Tutor's Diary

DATE	TRAINEE'S NAME	REACTION	RELATED TOPIC

Appendix B

B.1. Method U1: Heuristic Evaluation Materials

B.1.1. 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.

B.1.2. 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.					

B.2. Method U2: User Testing Materials

B.2.1. Instructions

You will be asked to perform several tasks with the E-Learning system. The purpose of the study is to improve the efficiency of working with the system.

While performing the tasks, an observer will watch for your actions. The session will also be videotaped. Your personal information will not be disclosed to anyone. A special effort is made that your face will not appear in the video.

Remember that what we are testing is the system, not your performance. You are free to stop the testing anytime you like.

B.3. Method U4: User Satisfaction Materials

B.3.1. User Satisfaction Questionnaire

E-Learning system Users 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 understood.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

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

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

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

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

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

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

13. I can easy found the information I need.

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

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

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

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

strongly disagree ❍ ❍ ❍ ❍ ❍ ❍ ❍ strongly agree

---

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

17. Are you Male or Female?

Female
Male

18. What is your age? years.

19. What is your job position:

20. Please, write down the name of the course you are studying with the E-Learning system:

Please check your answers. When you are done, push the button below.

finished

Thank You!