

# AN EVALUATION OF THE USEFULNESS OF WEB-BASED LEARNING ENVIRONMENTS

## The Evaluation Tool into the Portal of Finnish Virtual University

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### **Abstract**

Web-based learning environments have been widely developed, adopted and as a consequence a large amount of data has been collected from various web-based teaching experiments. Often platforms, web-based courses and web-based training services have been evaluated from rather narrow points of view. Further development of evaluation should to be based on a multidisciplinary framework right from piloting to the establishment of the web-based learning practices. A multidisciplinary evaluation framework is needed to define the factors critical in the implementation of training services for a given group of learners, as well as teachers and researchers of web-based courses. Because one evaluator (typically a teacher, designer or planner) can hardly be an expert on all the fields of science needed in evaluation, a multidisciplinary evaluation framework has been created to help the evaluators to pay attention to the critical factors of quality of web-based learning. The purpose of this paper is to describe an evaluation tool based on a multidisciplinary evaluation framework of web-based learning.

**Keywords:** evaluation, web-based learning, usability, pedagogical usability, accessibility, informational quality

### **1. Introduction**

To obtain authors information about good practices on web-based learning in the technical sciences the researchers of Virtual University of Tampere University of Technology (TUT) evaluated various virtual university pilot courses. The evaluation process consisted of pedagogical and usability sections. The researchers paid attention to how the learning context and pedagogical appropriateness were taken into account in user interfaces, tools, tasks, quizzes and in planning, designing and implementation of content production. The evaluation process was very useful for teachers and designers: They got tips and advice based on research results and theoretical viewpoints to develop their web-based courses. The evaluation process was quite laborious (Verkko-Pakki 2002.) To help the work of evaluators researchers started to develop an evaluation tool, which will in the future make the evaluation of web-based courses faster and easier.

The purpose of this paper is to describe an evaluation tool based on a multidisciplinary evaluation framework of web-based learning. Because one evaluator (typically a teacher, designer or planner) can hardly be an expert on all the fields of science needed in evaluation, the evaluation tool (with the multidisciplinary evaluation framework) has been created to help the evaluators to pay attention to the critical factors of quality of web-based learning. The multidisciplinary evaluation framework

is needed to define the factors critical in the implementation of training and learning services for a given group of learners, as well as teachers and researchers of web-based courses.

The evaluation tool was developed at the Hypermedia Laboratory of the Digital Media Institute (DMI) at TUT in co-operation with the Virtual University of TUT and with the Finnish Virtual University (FVU). The evaluation tool will be integrated into the Education & Training Portal of FVU (<http://www.virtuaaliyliopisto.fi/arvo>).

The Digital Media Institute (DMI) is a research centre for information technology with international significance. Its main purpose is to organize and carry out multidisciplinary research in the broad field of digital media. TUT is specialized in the education and scientific research of technology and architecture. The mission of TUT is to provide the most advanced technical higher education and conduct research in the field of engineering. In addition to basic research in engineering and the natural sciences, the importance of applied research and product development is considerable.

## 2. Multidisciplinary framework of evaluation

Obviously it is essential to evaluate web-based learning environments from various points of view to improve a quality of them. In this paper we consider web-based learning environments as a whole which includes e.g. web pages which have been designed for educational use or platforms and contents as well as pedagogical and educational methods. The multidisciplinary framework of evaluation used based on earlier research on HCI (human-computer interaction), psychology and pedagogy as well as our own evaluation research which has foundation on the theory of **usefulness** of computer systems.

The multidisciplinary evaluation framework is needed to define the factors critical in the implementation of training and learning services for a given group of learners, as well as teachers and researchers of web-based courses. Main issues within this evaluation framework are **usability**, **pedagogical usability** and **added value** as well as **accessibility** and **informational quality** of web-based learning environments.

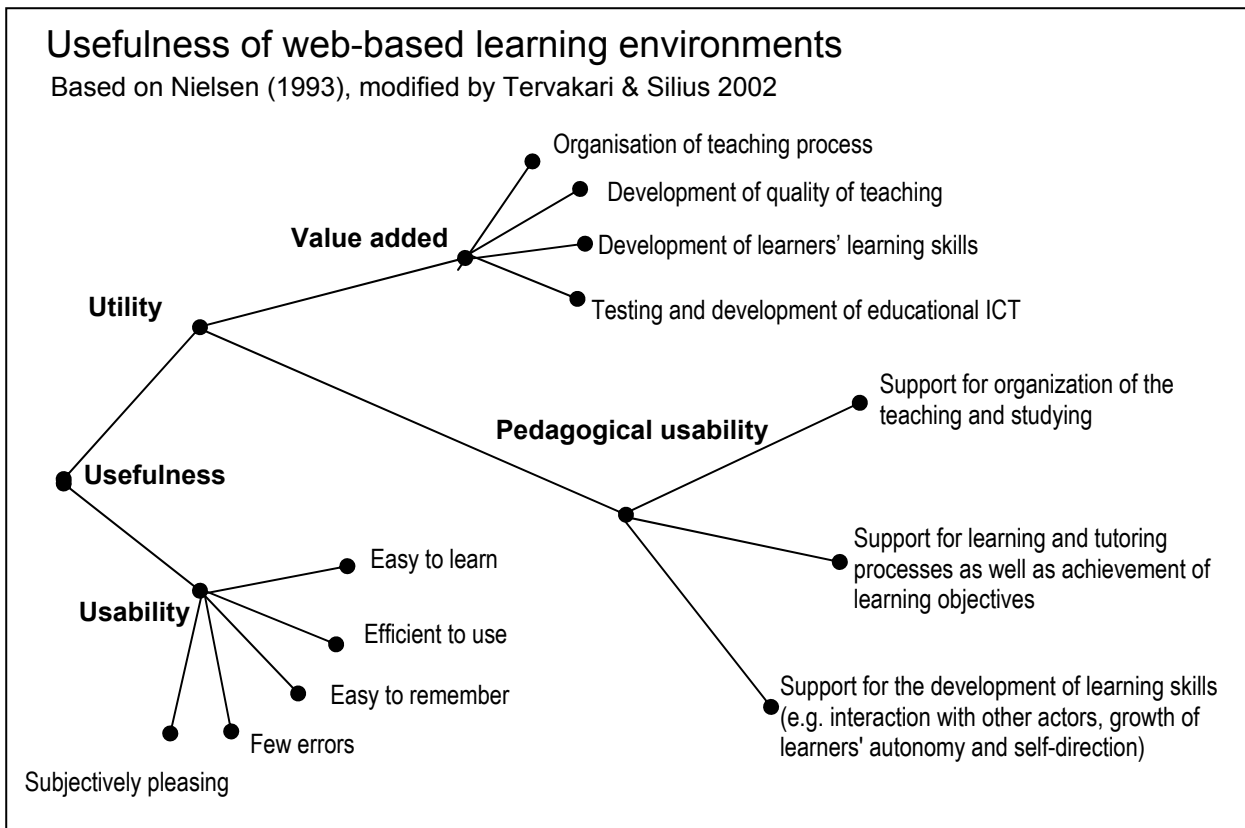
### 2.1. Usefulness of Web-based learning environment

According to Nielsen (1993) the overall acceptability of a computer system is a combination of its social acceptability and its practical acceptability. Practical acceptability includes some traditional categories such as cost, support, reliability etc. and also the **usefulness**. The usefulness can be analyzed further within two sections: usability and utility. (Nielsen 1993.)

**Usability** is one part of the overall acceptability of a computer system. Software of any type should meet the basic standards for usability. Usability evaluation is important part of the overall evaluation of web-based learning environments. The user interface of a web-based application must be easy and effective to use so the user can concentrate on the information content and learning instead of interface. When software is usable it is easy and efficient to use, easy to remember, it has few errors and it is subjectively pleasing. (Nielsen 1993.)

The concept of "**utility**" is quite general. Software has high utility if users can do what is needed with it. (Nielsen 1993.) To have high utility web-based learning environments must specially

support learning. (cf. Bostock 1996; Jonassen 1996; Quinn 1996; Soloway & al. 1996; Squires 1997; Tergan 1998.) We consider that in an educational context the concept of utility can be broken down into two main sections: **pedagogical usability** and **added value** of web-based learning and teaching (figure 1).



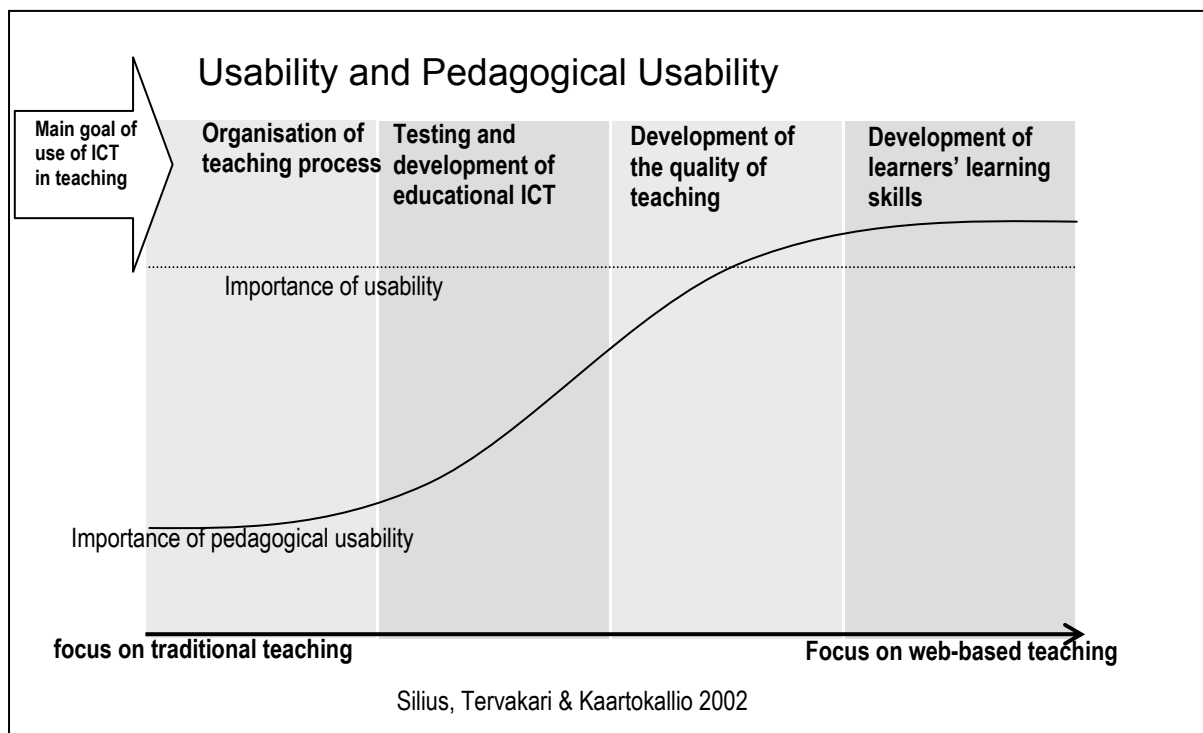
**Figure 1.** Usefulness of web-based learning environment is a combination of its usability and utility. Utility can be divided into two categories: pedagogical usability and added value of web-based learning and teaching.

In this paper we use the term "pedagogical usability" to denote whether the tools, content, interface and tasks of the web-based learning environments support various learners to learn in various learning contexts according to selected pedagogical objectives. (Tervakari & al. 2002.)

According to Silius, Tervakari and Kaartokallio the pedagogical usability can be divided into three main categories (ibid. 2002):

1. support for organization of the teaching and studying
2. support for learning and tutoring processes as well as the achievement of learning objectives (tutoring and designed learning processes should be based on appropriate, context sensitive learning and teaching model in which are taken into account motivation, reflection, co-operation, collaboration, reflection, knowledge construction, intention, activation, authenticity, contextualization and transfer (cf. Jonassen 1995, Mezirow 1997.)
3. support for the development of learning skills (interaction with other actors, growth of learners' autonomy and self-direction)

The categories of pedagogical usability have varying importance depending on how great a share of teaching occurs “in the web” and how much occurs in face-to-face situations and how much web-based learning is used in the teaching as a whole. In our opinion every web-based course should meet at the criteria connected with support of organization of the teaching process. If one uses web only for the organization of the teaching e.g. announcements, delivering material etc. that is enough. Instead if a teacher uses the web for teaching, to support the development of learners’ learning skills and for tutoring, the importance of other criteria for pedagogical usability is going to be greater. It is axiomatic that usability is always important. (Figure 2).



**Figure 2:** Relation between importance of usability and pedagogical usability.

Thus in an educational context the evaluation of usability is not enough. It is important also to evaluate the pedagogical design of web-based learning. It has to be remembered that the evaluation of the pedagogical design should not replace usability inspection. A web-based learning environment could be usable but not pedagogically usable and vice versa, although there could be some overlap in the problems identified. (cf. Albion 1999; Labbate 1996; Quinn 1996; Squires 1997.)

The evaluation of pedagogical usability should moreover always do in relation to selected pedagogical objectives and value added expected. Pedagogical objectives are influenced by learning objectives of substance as well as teaching and learning methods. In the evaluation of pedagogical usability should be paid attention to whether the pedagogical design of the learning environment is based on the appropriate educational theory and whether learners' unique skills (expertness of substance and web-learning skills) and needs like motivation, diversity and growth are taken into consideration.

In addition to pedagogical usability the utility of web-based learning environments should include value added of web-based learning. Actually the combination of new teaching media (in this case

the web) and the teaching method should produce some special value added for learners, teachers and organisations compared to traditional teaching. The best possible total benefits can be achieved if all partners can have special value added by using the web in teaching and learning. Added value in web-based learning and teaching can be broken down into categories: 1) organization of teaching process 2) development of the quality of teaching 3) development of learners' learning skills 4) development and testing of educational information and communication technology. (Forsblom & Silius 2002a; 2002b.)

In the evaluation of added value of web-based learning and teaching should be paid attention to the attitudes, expectations and experiences of learners, teachers and other actors. The realization of value added is connected with an individual's context. That is why the same web-based learning environment may produce different kinds of value added for different individuals. E.g. for those students who are working while studying delivering learning material via the web can be significant value added. For students who participate in lectures on campus this might not be value added at all. It has to be noted that the added value of a web-based learning is not necessarily dependent on usability or the pedagogical usability of the learning environment. E.g. learning material delivered via the web may have poor usability and poor pedagogical usability. Even though learning material in the web has some weaknesses, difficult to use, learners' different learning styles or different levels of knowledge not taken into account, content does not support achievement of learning objectives etc., it still can produce some value added for certain individuals.

## 2.2. Accessibility

An essential part of any web design today is designing for individuals with disabilities. Many governments and institutions nowadays require that web pages themselves should function with the assistive devices used by individuals with disabilities. Individual with disabilities should also be able to access information and fundamental government services on the web. Accessibility is an important step toward the equality of citizens and independence for individuals with disabilities. The World Wide Web Consortium (W3C) has established guidelines for the design of accessibility (Web Content Accessibility Guidelines) and checklists to evaluate the accessibility of web pages. (Foley & Reagan 2002.)

## 2.3. Informational quality

It is also important to evaluate the informational quality of web-based learning environment. To be of high quality the informational content of a web-based learning environment should meet the five main criteria: accuracy, authority, objectivity, currency and coverage. There are also some additional challenges presented by web resources e.g. instability of web pages, software requirements may limit access to information, web pages can be retrieved out of context, use on frames etc. (Alexander & Tate 1998.) From the viewpoint of pedagogical usability it is also important to ensure that the information as well as presentation of the content is relevant and suitable for a given teaching context. (cf. Albion 1999; Liu 2001; Tergan 1998.)

## 3. Web-based evaluation tool

Because one evaluator (usually a teacher, designer or planner) can hardly be an expert in many sciences needed in evaluation a multidisciplinary evaluation tool will be needed to help evaluators to pay attention to critical factors in quality of web-based learning environments. The evaluation

tool helps the evaluators to control the evaluation process and gather essential information. The evaluation tool can be used over the Internet. The evaluator may use the tool at the same time as he or she is evaluating e.g. a course in the web (Figure 3).

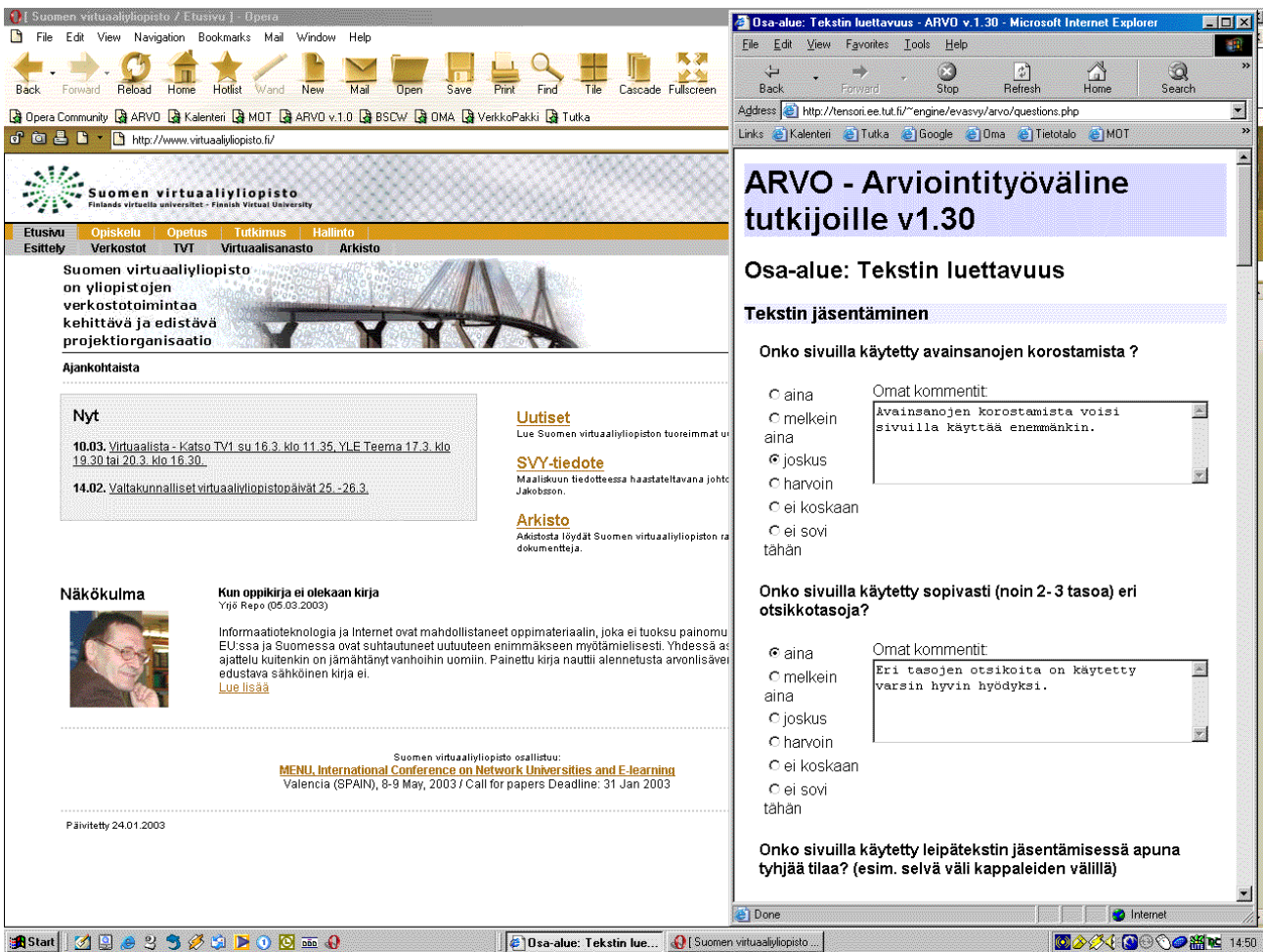
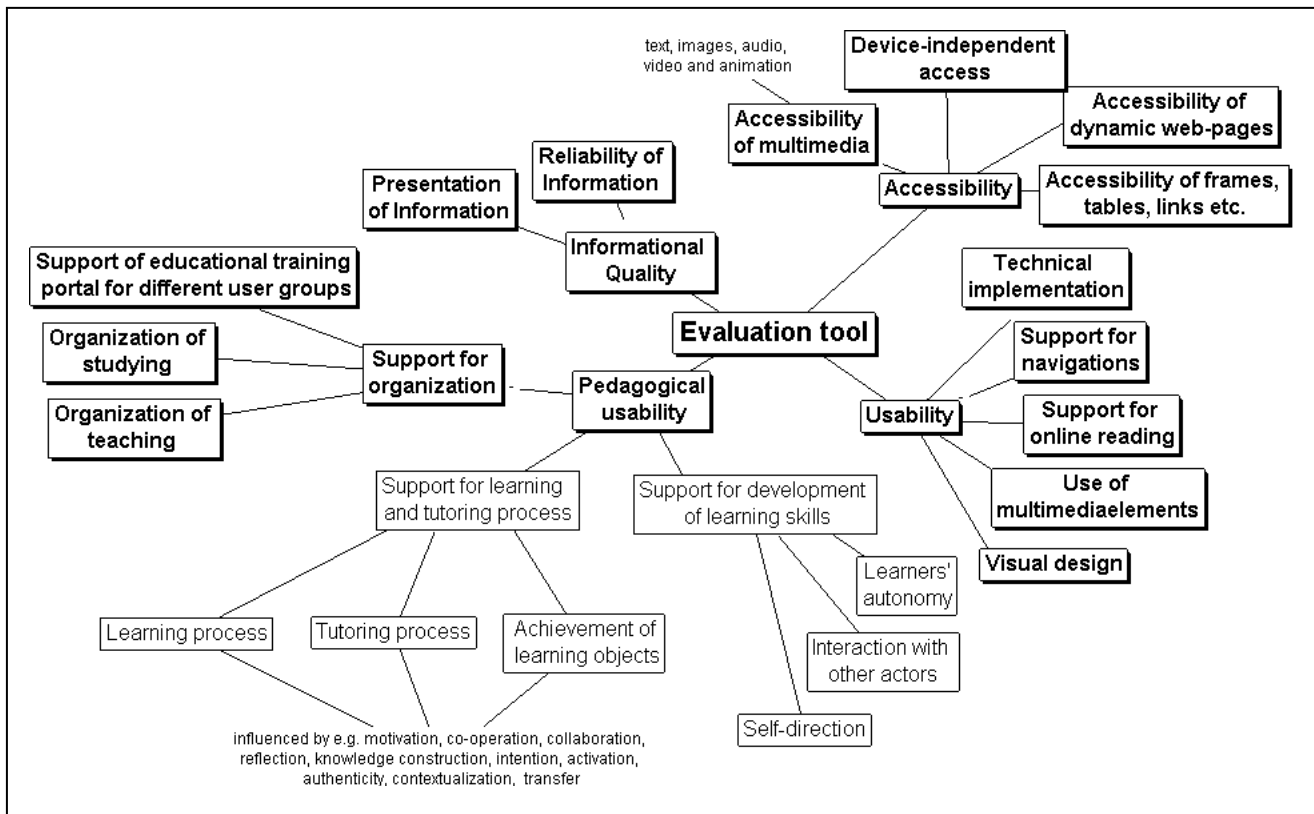


Figure 3. The evaluator may use the tool at the same time as he or she is evaluating e.g. a course in the web.

The tool takes systematically into consideration the most important factors of accessibility, informational quality, usability and pedagogical usability. **The pedagogical usability section** at first stage includes criteria to evaluate the support of the organization of the teaching and studying. In the second stage criteria will be developed to evaluate support of learning and tutoring processes, achievement of learning objectives as well as support of the development of learning skills. **The usability section** includes sections for evaluate visual design, the use of multimedia elements, technical issues, support for online reading and navigation, error prevention and support for recovery from errors. All sections includes around 4-12 criteria.



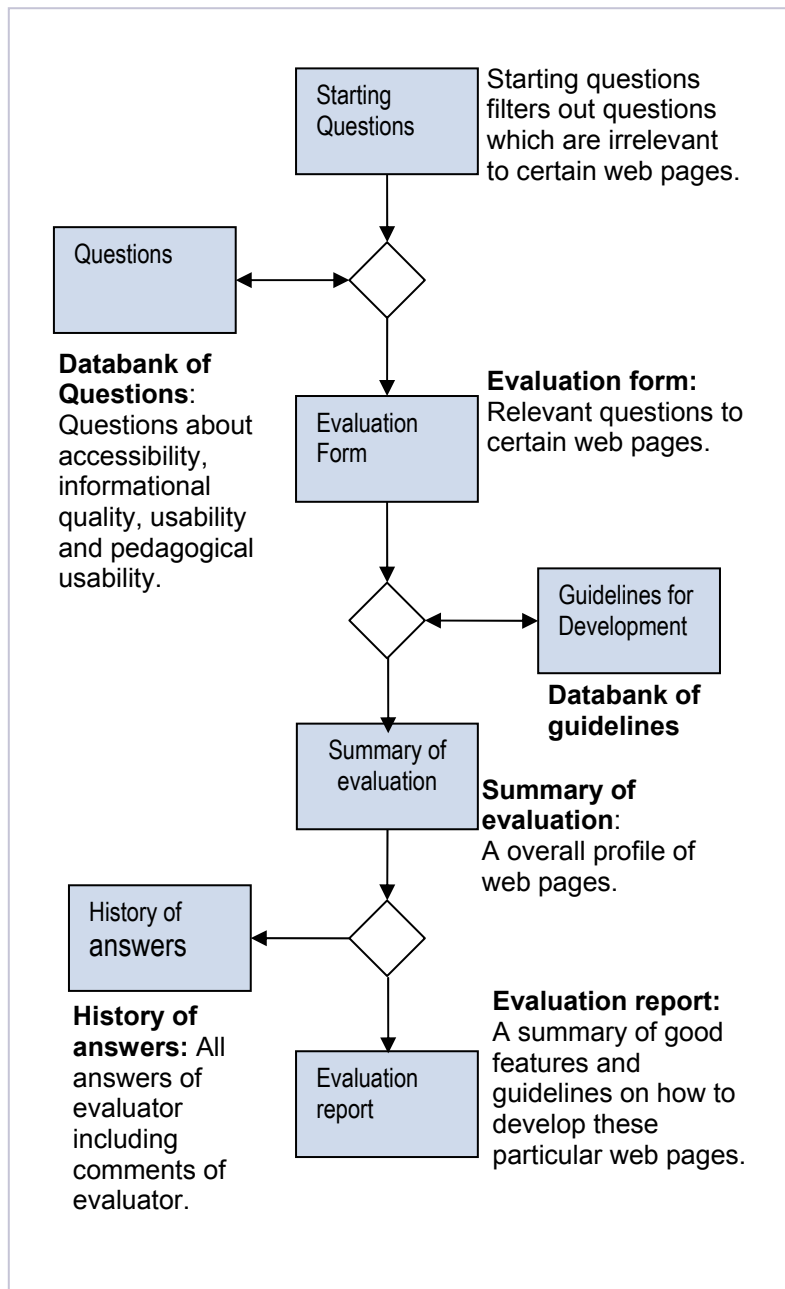
**Figure 4:** Sections of evaluation

To find out which degree a particular criterion has reached, the evaluator has to answer several (around 5-10) questions. The questions on each criterion are presented to the evaluator in a semi-intelligent form. It is possible for the evaluator to filter out questions which are irrelevant for certain web-based learning environments. E.g., if there is no video or audio in the web-based learning environment, all the criteria and questions connected to these media elements will be dropped from the final evaluation form. Also, if the web-based learning environment has been created on the purpose to support the organisation of the teaching and studying processes only, all the criteria and questions connected to other sections of pedagogical usability will be dropped from final evaluation form (See: Figure 5).

On the evaluation form each question is accompanied by rating scale (1=poor to 5= excellent; N/A "Not Applicable", "Don't know"). Evaluators are asked to rate the package of questions connected to each criterion e.g. visual design. The questions have been modified so that the evaluator does not have to think to which degree a particular criterion has been reached. The evaluator answers to simple questions like "is it possible for a user to change the font size of the web page by using browser settings". Alternatives for answers are "always", "often", "sometimes", "rarely" "never". Depending on the questions each alternative can have different scores e.g. "always" can be scored 1 or 5. Evaluators can also add relevant comments in the space provided (See: Figure 5).

After the evaluation the evaluator can have a report of the results of the evaluation. This report is composed of the overall profile of the web-based learning environment, a summary of the good features and guidelines on how to develop this particular learning environment. Guidelines are a

detailed description for upgrading usability, pedagogical usability, accessibility and informational quality. E.g. to improve the accessibility of web pages one should provide a text equivalent for every non-text element via "alt" (See: Figure 5).



**Figure 5:** The evaluation tool helps evaluators to control the evaluation process, gather essential information for further development.



## 4. Conclusions

We consider that further development of evaluation should be based on a multidisciplinary framework right from piloting phase to the establishment of the web-based learning practices. A multidisciplinary evaluation framework is needed to define the factors critical in the implementation of training services for a given group of learners, as well as teachers and researchers of web-based courses. We consider that researchers and teachers should pay attention to how usability, accessibility, pedagogical usability and pedagogical appropriateness are taken into account in user interfaces and in the planning, designing and implementation of information content. For example, a special attention should be paid to how the user interface supports the learners in finding appropriate information and how the information given on the courses supports the learners' decision-making process.

It is important that the tool makes it possible for teachers to evaluate their courses themselves. The whole tool (questions, advances, interface etc.) has been designed so that it is easy to answer the questions and understand given guidelines without being an expert in usability, accessibility or pedagogical usability. The evaluation tool will be also used as a designing tool.

The evaluation tool will be developed specially in pedagogical usability sections. The next step is to add criteria and guidelines for supporting tutoring and learning processes in the web and supporting the development of learning skills in the web. We consider that it is most important to develop this evaluation tool so that user-oriented factors and factors concerning learning tasks, objectives and contexts collected from real users of the learning environment (learners, teachers and assistants) will be included in the tool. The tool will help to match data collected from evaluators and real users.

In order to successfully develop web-based learning and teaching further the Hypermedia Laboratory and the Virtual University of TUT are doing joint research to identify the best practices and the conception of added value by investigating the advantages and disadvantages of web-based learning in various contexts. The data will be collected in the pilots of the Hypermedia Laboratory and the Virtual University of TUT and it will be used to develop the evaluation tool further.

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The Finnish version of evaluation tool is available in Internet at URL:

<http://www.virtuaaliyliopisto.fi/arvo/>

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