

# Teaching Economic Statistics in a Digital Environment

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## Abstract

Recent fascinating development of information and telecommunications technology (ICT) has made vast amounts of data available to many millions throughout the world. Official statistics represents important segment of these data. Widespread and increased use of conceptually and methodologically complex official statistics requires appropriate users' training. The central issue of the paper is the question how modern ICT could be used to increase quality and efficiency of users' training in the field of official economic statistics. Three strategic areas of ICT application in the course development process are identified: extension and deepening of student's access to information, increased flexibility of study delivery and integration of student's learning experiences and knowledge. The paper outlines the course development methodology designed for effective integration of ICT and contents by the Faculty of Economics/University of Ljubljana. The adaptation of the basic user interface developed by the Faculty of Electrical Engineering/University of Ljubljana to specific course requirements is also described.

CEES Project Homepage: <http://www.ef.uni-lj.si/projekti/cees/>.

## 1 Introduction

Commercial and non-commercial electronic databases on mass storage and distribution media provide large, highly focused data-sets. These are particularly common in the field of business and economics. Business and economic databases usually contain statistical data, which are heterogeneous in terms of their providers, media, accessibility, contents, etc.

Among the most important providers of statistical data in the field of business and economics are national and supranational statistical agencies or other institutions, which are authorised by law for collection, production and

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dissemination of official statistical data (official statistics) according to theoretically founded and officially approved methodologies. These data represent the basis for important part of research and decision making processes in the field of business and economics. As data users should be familiar with methodologies behind the data, these should be given particular attention in specialised credited or non-credited statistical courses on higher education level. Unfortunately, the survey of available courses on business and economic statistics courses shows that the need for appropriate users' training is somehow neglected.<sup>2</sup>

The initiative<sup>3</sup> for the development of a modern course on official statistics had thus risen from the non-existence of a course on official economic statistics which would meet the needs of the well-defined target groups in terms of its contents, level and flexibility on the one and exploit the tremendous possibilities of the modern information technology on the other hand.

Given the existing teaching experiences and the real need for the economic statistics course modernisation (the course is taught at the Faculty of Economics/University of Ljubljana), it was decided to develop a pilot on-line course of European Economic Statistics (acronym CEES) for the post-secondary educational level of 90 study hours.<sup>4</sup>

The consortium of CEES course development partners includes Faculty of Economics (FE) and Faculty of Electrical Engineering (FEE) from Ljubljana/Slovenia, Faculty of Economics and Business Administration from Sofia/Bulgaria and the Training of European Statisticians Institute from Luxembourg. CEES development was financed by Phare funds in the framework of the Phare Multi-Country Programme in Distance Education - Course Modules Development Project.

## **2 Identification of strategic areas for effective ICT implementation**

The main objective of the CEES was to develop the original course module of economic statistics for non-statisticians at the higher education level, taking into account recent developments of Eurostat statistics. The available information and

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<sup>2</sup> In Europe, Eurostat (in cooperation with the Institute for Training of European Statisticians - TES) is giving considerable attention to training of professional statisticians in EU and CEE countries. However, the initiative of training wider (non-professional) audience is left to the countries themselves. Within formal educational systems, the topics that deal with official statistics are seldom included in formal or non-accredited study programs. Exceptions include e.g. Germany, Italy, Sweden and Slovenia, where methodological issues have been traditionally covered in university courses of Economic Statistics/Wirtschaftstatistik/Statistica Economica.

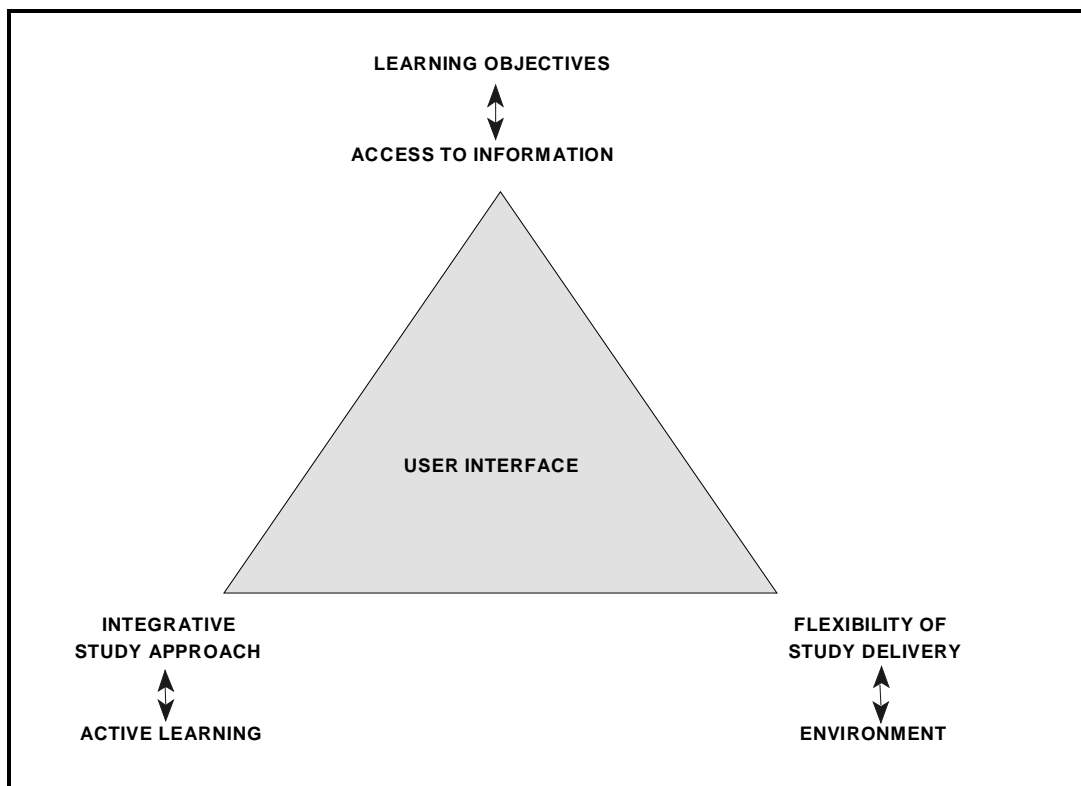
<sup>3</sup> See Phare Multy-Country Programme in Distance Education, Proposal No. DE97/297, Development of Distance Education Course Module on European Economic Statistics, Faculty of Economics, University of Ljubljana, Ljubljana, 12 September 1997.

<sup>4</sup> The project was financed by Phare Programme for Multi-County Cooperation in Distance Education, Course Module Development Projects, Contract No. ETF/97/VET/0068.

telecommunication technology (ICT) should be used to enhance educational possibilities in innovative way from the viewpoint of the course access, contents and level, in order to meet diversified needs of different target groups (e.g., students of business and economics, students of social sciences, government officials, researchers and analysts in both private and public sectors, journalists, etc.).

The prevailing idea was that the course on economic statistics by its very nature (focused on the appropriate use of large scattered decentralised databases diversified by various aspects, e.g., by users, contents, type of data, media, etc.), could profit substantially from the creative use of ICT. In other words, the use of ICT can increase the quality and efficiency of the course in three strategic areas:

- extension and deepening of researchers' and consequently students' *access to information*,
- increase in the *flexibility of study delivery*;
- *integration* of students' learning experiences and knowledge.



**Figure 1:** Strategic Areas of CEES Development by ITT Support.

As shown in Figure 1, access to information, flexibility of study delivery and integrative study approach are considered to be *crucial strategic areas* that help increasing efficiency and quality of study when using modern technology in the field of economic statistics. Their identification is derived from *specific course requirements* which include:

- *main learning objectives* of the course on economic statistics;
- *teaching/learning environment* in which the course delivery actually takes place;
- *active learning style*.

For effective integration of ICT into the course, FE designed the *special course development methodology* whereas FEE contributed the software support. FEE's previously developed *Integrated On-line Distance Education System* was adapted to specific CEES course needs. The main strategic characteristics of both course development methodology and adaptation of software support to specific course requirements are outlined in the following sections.

## **2.1 Course development using ICT: Extending and deepening access to information**

In the information society, studying and solving real-life problems equals using the potentials of hypermedia whose *main advantage* is non-linearity.<sup>5</sup> In practice this means that the user does not have to follow a course in a set manner (e.g., page 1, page 2 or chapter A, chapter B, etc.) as in a traditional learning process. Instead he/she has a freedom to roam around the application, to move from one node to another via semantic links, searching for desired information.

The loose, associative and non-sequential structure of hypermedia systems can also be a *disadvantage*. Hypermedia are not well suited to situations where directed learning is required as it is the case of an undergraduate course on economic statistics, where the sequence of chapters and the hierarchical structure of the course are defined by logical relationships among the studied topics.

Additional danger of hypermedia is a high level of students' temptation to click on links as they appear and go from node to node without any serious attempt to assimilate the information contained in individual nodes and thus not gain the knowledge specified in learning objectives.

In order to keep the advantage of hyper-media non-linear study possibilities and to fulfil the requirements of direct learning imposed by the learning objectives of the CEES, a specific course development approach was developed. It is based on the course *contents modularization combining linear and non-linear study paths*.

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<sup>5</sup> See F. Riley(1995): *Understanding IT: Developing Multimedia Courseware*. University of Hull, 42.

The fundamental hierarchically built structure of a traditional course is split into topics. Each topic contains several blocks. Blocks embody course contents (Overview, European Standards, National Application) or pedagogic support with guidance to additional sources of information (Objectives, Activities, Resources, Links).

The breakdown of the course by topics and blocks leads to a matrix presentation of the course, which helps course developers to create nodes and links in a consistent, transparent and meaningful way (see also Figure 2).

<i>Topics</i>	Blocks	Objectives	Over view	European Standards	National Application	Activities	Resources	Links
<i>Introduction</i>		Html Page 1_1						Html Page 1_7
<i>Statistical Units</i>								
<i>Classifications</i>								
<i>Registers</i>								
<i>National Accounts – Principles</i>								
<i>Description of Accounts</i>								
<i>Index Numbers – General</i>								
<i>Prices</i>								
<i>Integrated Systems of Index Numbers</i>								
<i>Population and Labour Force</i>								
<i>Production</i>								
<i>Labour Input and Productivity</i>								
<i>Sources of Statistics</i>								
<i>Statistical Analysis</i>								
<i>Internet</i>		Html Page 15_1						Html Page 15_7

**Figure 2:** Matrix presentation of the course.

Each cell in the matrix represents a basic html unit. If necessary, some cells can be further divided into new html pages or can be left empty. Each html page can contain *several types of links*: explanations and cases within an html page (in the so-called “pop-up” window); internal links (links to pages within the course) and external links (links to outside web-sites). All these features are supported by the corresponding navigational tools.

## 2.2 Course development using ICT: Increasing flexibility of study delivery

Flexibility of study delivery is the distinctive feature of distance learning, which can be fundamentally enhanced by tremendous possibilities of modern ICT. Not

only is the study delivery no longer dependent on the teacher's and students' presence on the same geographical location (which is especially important for part-time and distance students). The important fact is that the quality of study delivery can be improved by increased flexibility also in the "traditional" classrooms.

The course flexibility can be achieved through specially prepared *study materials* (based on experiences from printed distance education self-study materials preparation projects) and through professor - tutor - students communications via advanced *communications channels* (e. g., videoconferencing<sup>6</sup>, e-mail, chat groups, etc.).

### **2.3 Course development Using ICT: Integrating students' learning experiences and knowledge**

Active learning is based on the presumption of students' ability to creatively link together information and knowledge from different sources and manage a breakthrough in order to gain and retain new knowledge. Such an integrative study approach is facilitated by ICT tools. The majority of them are standardised and available in common software packages.

It is planned that CEES students should have access to and knowledge how to use the following standard programmes:

- *Spreadsheet Programme* (students of statistics should know how to use the spreadsheet and how to write simple formulas; in addition some programmes can also play the role of a simple statistical package);
- *Calculator* (needed for simple calculations while solving testing problems);
- *Text Editor* (needed for notes preparation while studying);
- *Adobe Acrobat Reader* (needed for the majority of official statistics providers' files examination);
- *Netscape Navigator version 4.5 or later or Internet Explorer version 5.0 or later* (obligatory for the functioning of the users' interface and net navigation).

The preparation of the CEES course is based on the presumption that students have access to these standard tools - either at home, at work, at the faculty or at the study centre.

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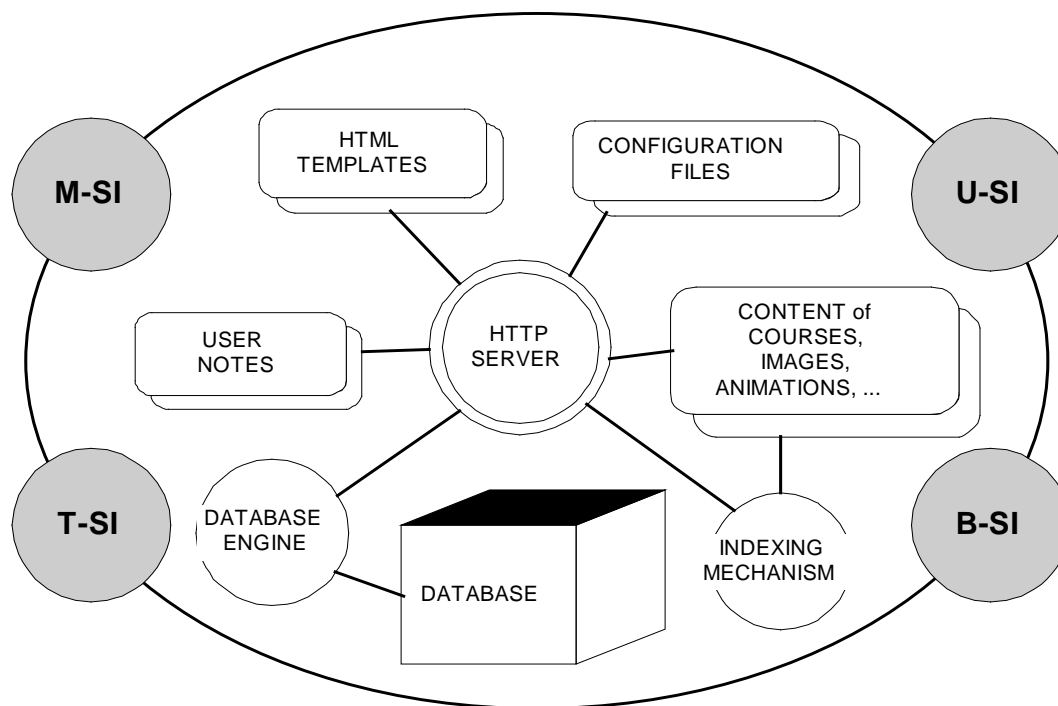
<sup>6</sup> At the FE, the use of videoconferencing in the course on economic statistics was tested along with the distance education self-study materials. Although its advantages and disadvantages are not fully comparable with normal classroom routine, videoconferencing proved to be useful in introductory and explanatory sessions with students. More on videoconferencing experiences see in L. Bregar: The Potential of Videoconferencing as a Study Support Form in a Distance Study Programme. 7<sup>th</sup> EDEN 1998 Annual Conference, University of Bologna, Italy, 1998, 120 - 123.

### 3 Technological (software) support: Integrated on-line distance education system

The basic user interface was developed at the FEE.<sup>7</sup>

*Integrated On-line Distance Education System (IODES)* functionally consists of four parts: the User - System Interface (U - SI), the Tutor - System Interface (T - SI), the Visitor - System Interface (B - SI) and the Manager - System Interface (M - SI). The two main interfaces, the User and the Tutor - System Interface, support two functionally completely different elements of educational programme, which are interconnected by the users, educational course and the efficiency of the educational programme.

From the technical point of view, the IODES is based on Internet services. However, standard Internet services (e.g., WWW) do not permit the individualisation of the study environment and differentiation among individual users. Thus, they do not facilitate individual performance monitoring. Therefore, the key task in the system development was the preparation and integration of specific functions, needed in the distance education processes, using a special FEE server.



**Figure 3:** Components of an on-line distance education system.

<sup>7</sup>As described in the CEES project proposal. See Phare Multy-Country Programme in Distance Education, Proposal Nr. DE97/297, Development of Distance Education Course Module on European Economic Statistics, 12 September 1997, 5 - 8.

The apt solution proved to be a connection of the server with a relational database. The data model consists of four types of data:

- data on system users and individual courses' tutors;
- data on server's contents;
- data that connect users with courses, course pages and exercises solutions;
- provisional data on users that are currently logged on to the system.

The content of the database reflects the "last state" of the user's work. All the user's actions are precisely logged in special log files. The study path of an individual user in the system can be accurately traced. The architecture of the system is shown in the Figure 3.

Functionality is performed by a series of CGI (Common Gateway Interface) programmes. Every particular operation in the system (e.g., logging in to the system, selection of the course, pursuing links between different course text pages, etc.) is supported by another CGI programme. The result of their execution can be either HTML content pages viewed in users' Web browser, or results of the evaluation, answers of the assessment questions etc.

It is important to point out that the graphical appearance of the user's and tutor's interfaces is mostly independent from their functionality.

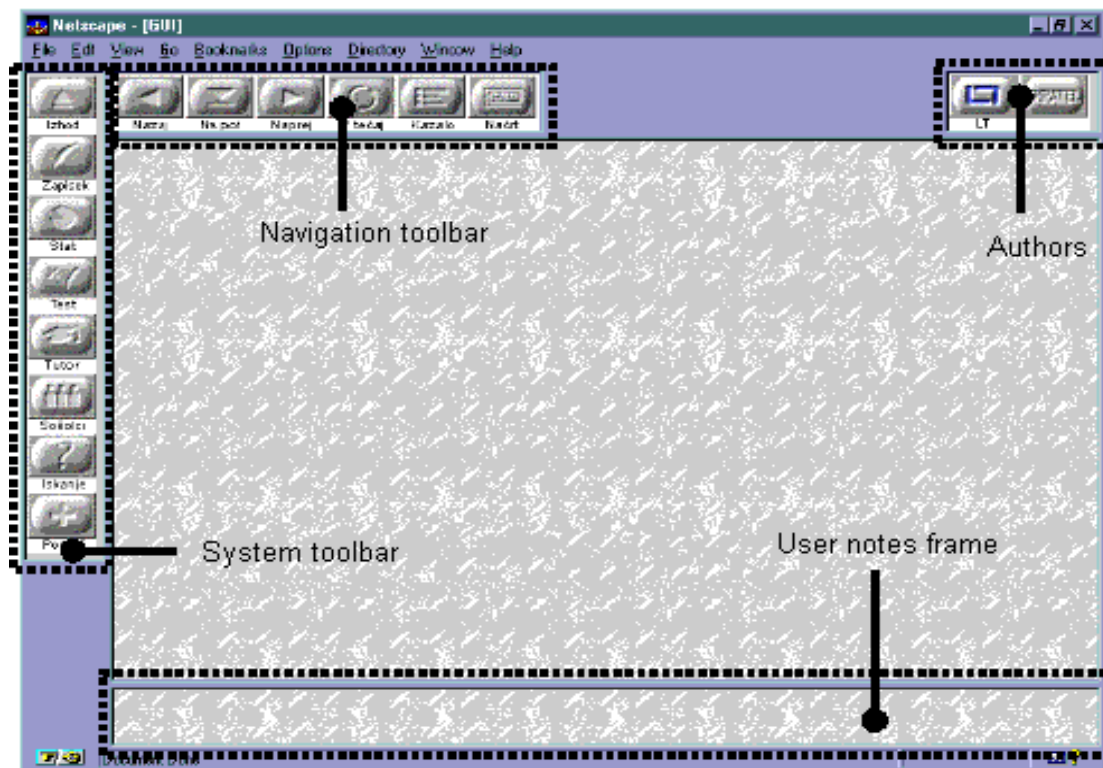


Figure 4: Basic user interface.



### 3.1 Adaptation of software support to specific course requirements

Although, from the technical point of view, the IODES was acceptable for CEES, it did not fully correspond to specific course requirements as defined by the strategic areas of ICT implementation. In order to meet these needs, the system was adapted in two main areas. Adaptations were either related to the graphical users' interface or to the system functionality.

The main features of basic user's interface graphical amendments as well as the changes in the system functionality are illustrated in Figures 4 and 5.

At the upper end, the CEES user interface has a toolbar which includes navigation and system function call buttons. The latter are organised in five groups: Topics, Study, Tools, Communication and Help (see also Figure 6). The first four groups are related to CEES strategic areas: access to information, integrative study approach and flexibility of study delivery.

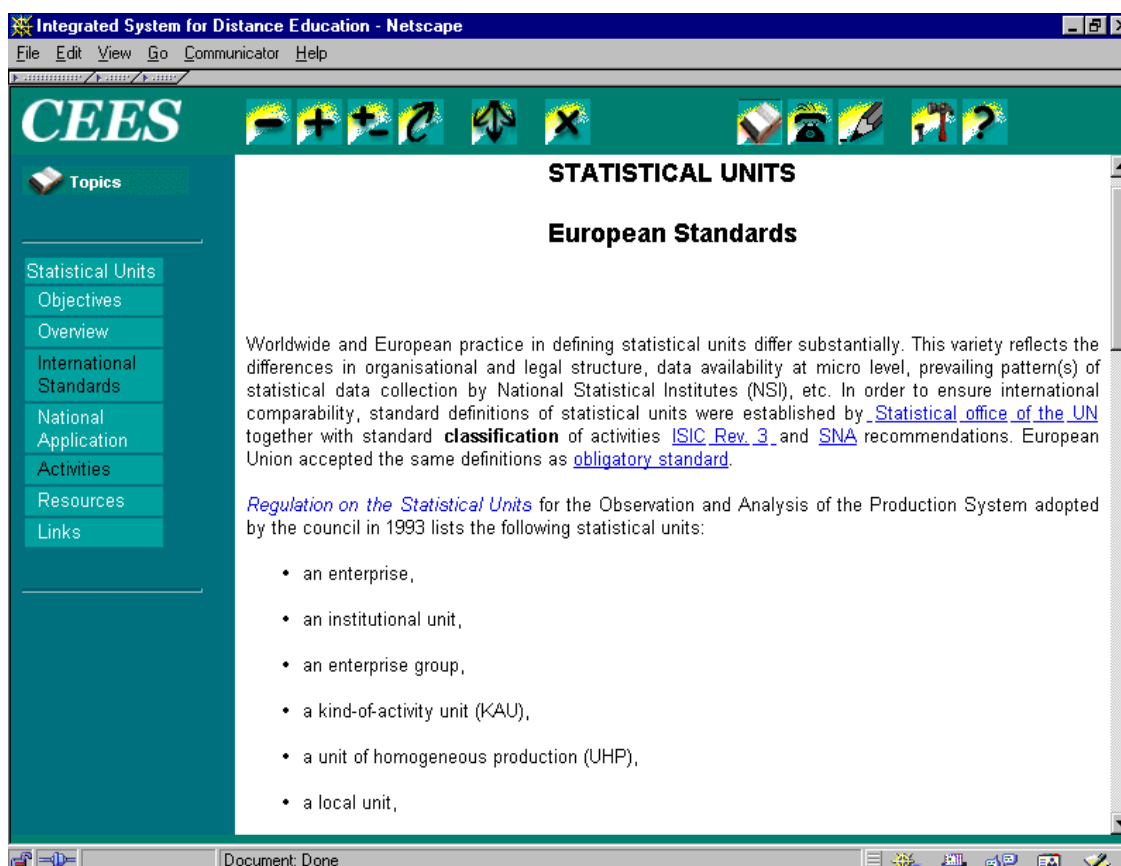


Figure 5: CEES user interface.

LEARNING OBJECTIVES/ ACCESS TO INFORMATION		INTEGRATIVE APPROACH	STUDY DELIVERY	HELP
COURSE/TOPICS	STUDY	TOOLS	COMMUNICATION	
Objectives	Progress	Calculator	E-mail (Tutor)	General
European Standards	Evaluation	Search	Usenet	System
National Application	Study Profile	Notes Editor	Notice Board	Course
Activities	Personal Profile	Written Notes	Videoconference	Bugs
Resources	Notice Board	Question Mark		
Links	Study Office	Statistical Methods		
		Library		
		External Links		

**Figure 6:** User interface as adapted to strategic areas.

In addition, some *new system functions* were developed for CEES. The most important are the following:

- simultaneous support of different graphical interfaces;
- classification of the contents' pages by various criteria;
- creation of different tables of contents reflecting user's selection of particular contents' topic;
- mechanisms to create and retrieve messages on an electronic announcement board;
- summary presentation of the users' annotations and notes;
- interactive study map.

New functions were specified and possibilities for their implementation were created within the scope of the system architecture. The system's adaptations were implemented and tested. They might be further improved in the future.

## 4 Pilot delivery and evaluation

The creation of CEES html pages with all types of links was finished at the beginning of 1999.<sup>8</sup> Pilot course delivery was carried out in February and March 1999 at the University of Ljubljana/ Faculty of Economics as a part of a regular second year undergraduate study programme. It was run in two separate (distinctive) delivery formats: in *a traditional distance education format* (with about 100 students) and in *a virtual classroom* (with 15 students).

<sup>8</sup> The present outcomes of the project are a printed textbook, an on-line course with 315 html pages and a CD-ROM course version, all of them in English and Slovene language.

Pilot delivery was followed by a comprehensive *formative and summary evaluation* based on students', tutors' and independent external experts' participation.

A *survey* was carried out among the students of both study groups using two different questionnaires.

61 students of the *traditional distance learning class* were included into a survey, which is more than a half of the whole population. The survey revealed that as many as 92% of the students were satisfied with the textbook quality judged by its graphical appeal, writing style, the extent and selection of topics, the adaptation to the demands of the independent learning and the quality of activities and assignments. Most students missed the keys to activities and some additional examples with detailed explanations. They were satisfied with the possibility of independent learning.

The survey in the *virtual class* included eight students. They thought that the user interface did not take too much time to load, was very well designed and user friendly, allowed a simple and comprehensive navigation and offered a lot of internal and external links and an interesting set of supporting tools. They gave the highest grade to the selection of topics covered in the course and the external links satisfied even the most critical of them. They found the text graphically very appealing and the writing style very fluent. They also highly graded the interactive study map with its colourful and transparent course structure (although it might take too long to load in case of a slow on-line connection) and a pre-set pop-up window for the tutor's e-mail. Good working atmosphere finally resulted in highly graded communication with the professor and tutors.

The students were the least (but still quite) satisfied with the search and help functions which have been upgraded since pilot delivery. They emphasised the time consumption: the study of the subject took them a lot of time. They felt that at the beginning they underestimated the extent of the course.

Nevertheless, the students found the on-line study mode very interesting, different from the traditional one, attractive, demanding active participation of students and supporting more and different ways of communication with the professor and tutors. They appreciated the interchange between theory and practice, which made the studied subject much more interesting and – as one of them declared - the knowledge lasting longer.

*Independent external experts* (TES Institute Luxembourg, Statistical Office of the Republic of Slovenia, University of Ljubljana/Faculty of Economics) also positively evaluated the CEES course and its pilot delivery. They found the navigation very easy, the design attractive, and the external links relevant and interesting. In their view the course provides concise information on the theoretical aspects, on the international and EU statistical standards and on the national practice in the field of economic statistics. It is thus very useful for both undergraduate and graduate students as well as for junior statisticians starting their careers at the national statistical institutes.

The *main findings* of the pilot course delivery and its evaluation are listed below:

- Students were highly motivated to embark on a new way of study, but their insufficient skills for independent study and use of modern information technology forced them to rely heavily on the pedagogical support; consequently teacher-student interaction by various communication means was improved, but teachers' workload also increased.
- Development of an on-line course is not a finite action, which is terminated by instalment of the course on Internet. The Internet dynamism itself requires continuous upgrading and updating of an online course. The rigidity of a traditional university heavily jeopardises these newly emerged tendencies and needs for flexibility.
- The traditional distance learning format can be regarded as a compromise between a virtual class and lectures emphasising active self-study, but allowing more face-to-face contacts in the form of tutorials, workshops and consultations. It can be viewed as a possibility to improve the quality of learning in a mass study environment.
- The pilot course delivery showed that learning process based on hyper-media imposes new pedagogic concepts and new operational criteria for students' assessment.
- On-line learning makes life-long learning easier and more feasible. The concept of a life-long learning is of a special importance for statisticians and users of statistics because of constant changes and updates of professional knowledge and expertise, induced mainly by permanent technological progress and harmonisation processes in the field of official statistics.

## 5 Conclusion

In this paper we presented our view of an on-line course development process. Its salient point (assumption) is the awareness of the changing roles of teachers and students (teachers are not only providers and students are not only passive recipients of information).

Obviously, compared to traditional educational programmes, an on-line course is much more complex and demanding in terms of its development procedures. An appropriately designed on-line course enhances the complexity of an educational product because it integrates various educational services (e.g., self-developed study materials combined with outside on-line sources, administrative and study support services, etc.) into one integral product mix. Thus, it brings more flexibility into the learning process in terms of contents, time, pace and place of study. The integration of various educational functions into one product makes the quality aspects of educational process more transparent and open. Knowledge, co-operation

and team work of course developers (teachers), information technology experts, web pages designers, translators, official statistics providers, administrators in study centres, etc. were indispensable for the CEES development.

In the course development process, we learned a great deal about official statistics providers, web sites' information organisation and structure and also about our own strengths and weaknesses. Research carried out within the CEES project indicates that the on-line dissemination of official statistics is still in its initial development stage. For thorough future exploitation of the ICT advantages in the field of economic and business statistics, systematic and cooperative research efforts of academics, professional statisticians, information technology experts and users are needed.

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