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Distance Learning experiments between two Technological Education Departments of Informatics in Greece

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Abstract: In this work a non-prescriptive methodology framework for the instructional planning and tutoring of online distance courses and its application to a Distance Learning experiment between two Technological Education Informatics Departments in Higher Education are presented and briefly discussed. This framework is based on Content – Instruction and Tutor - Learner Centered Approaches and consists of the following: capturing of Strategic Decisions, conducting requirements analysis and specifying the Scope of the course. Planning and "Re-engineering" process are also included. Design, allocation and units' standardization form a basis for Instruction, which is seen as a Workflow process. The presentation is combined with an overview of the distance learning experiments between the two departments. Eventually, a preliminary summative evaluation, the received feedback from the students and second thoughts for future activities are presented.

Keywords: Distant courses design methodology, Distance learning experiment

1 Introduction

Designers and Tutors of online distance courses can use various instructional strategies and material. But instructional interaction must exhibit some specific characteristics. They have to make (and change) decisions related to the selection and sequencing of the instructional material, specify when and how to cover students' needs during the phase of practicing specific skills and understand when to respond to students' difficulties about the subject matter. The designer / tutor needs to be

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aware during the stages of the design of an online, distance course that solid body of theory and practice is already established, in the context of distance tutoring. Therefore, a non-prescriptive methodological framework based on activities and task sets could be captured / extracted from published research results and practitioners' experience related to the nature of learning, the nature of teaching and the nature of the subject matter. Such a framework spans a Content – Instruction and Tutor - Learner Centered Approach. More precisely, we try to capture, examine and explore the COIN-relationship between Content and Instruction (COIN–relationship, COntent INstruction) and the TULE-relationship between Tutor and Learner (TUTLE-relationship, TUtor, LEarner). Such a work forms a basis for the extraction of useful characteristics that are incorporated into the methodological framework. In the next sections the proposed framework is presented and discussed.

1.1 Curriculum, instruction and instructional design models

Traditional Instructional design models have been usually used for the development of instructional systems. Such models generally tend to be linear, step by step guides directing the tutor through a series of necessary stages. A number of different processes could be used for the development of instructional systems using educational technology [1].

1.2 A combined COIN_TULE (COntent–INstruction, TUtor–LEarner) Centered Approach applied to the requirement analysis activity.

Our method puts the Learner at the Centre to improve the tutor's and designer's understanding.

A brief list of task set elements (items) which can be included in complex (mixed) tutor-learner and content-instruction centered requirement analysis activity includes [2]:

Understanding of the target audience (learner).

The goals of the project (course) must explain what the learner is expected to learn, what s/he should be able to accomplish and how long it should take.

Specific learning objectives must be defined for every instructional unit - "lesson" (detailing what is to be learned).

Detailed Description of the content to be included.

Outline of topics and subtopics to be covered.

Design and sequencing content of the course.

1.3 Issues and building of Instructional Environments

As we have already mentioned, the problem of distance experiments could be also tackled as a strategy that encompasses specific processes, methods, and tools. These layers can be related to the well-known Software Engineering paradigm which suggests a systematic, sequential approach that begins at the system level and progresses through analysis, design, coding, testing and maintenance [2]. It is also influenced by the well-known Business Process Modeling approach [3].

1.4 A brief outline and discussion of the framework

To combine elements of all the above mentioned approaches we propose the use of a framework that consists of the following functions:

Strategic Decisions, needs analysis, and Scope.
Planning, and Reengineering process
Design, allocation and units' standardization
Workflow process - Instruction
Evaluation, feedback and future activities

In the next sections we briefly discuss the following: Section 2 expresses the decisions which direct our choices, mainly related with the demands of the IT-Market for professional skills; Sections 3 and 4 explain the planning and design of our framework; Section 5 presents the sub-tasks related with our framework in more detail which directed the design of our experiment; section 6 presents the designing of the evaluation process and the construction of the supporting material; section 7 concludes and presents directions for future work.

2 Strategic Decisions, Requirements Analysis, Scope.

This activity focuses on the problem, conducts preliminary needs' analysis, examines various ways to meet the needs and accordingly conducts the appropriate Cost benefit analysis.

2.0.1 IT Labor Market Considerations

Both Departments share the same thoughts related to the considerations of the Labour Market. A survey of the Greek IT Labour Market [4] revealed that more than 60% of the demand for IT professionals was considering DB Technology expertise as "required" or "strongly recommended". Concerning specific products, Oracle seems to be the champion (32%). On the other hand, it is well known that, for many of the graduates of the Department of Informatics of the TEI of Athens,

where Oracle is, since a long time, the main training tool for DB technology, DB technology is a “ticket” to the profession.

2.1 Shortage of resources

The driving forces behind our efforts have been the limited time and human teaching resources, due to the low ratio of the permanent teaching staff in respect to the continuously growing number of students in the Informatics Departments in Greece [2]. There is an ongoing explosive expansion of the Greek highest education, which has further aggravated the situation [5].

2.2 Quantitative & Qualitative Data collected in the TEI of Athens

The evaluation during the last four years revealed a major difficulty in database design and implementation. Hence, an emphasis must be given in the following:

More than 160 students attend lectures in Database I (two hours /week), and more than 100 in Database II (two hours /week).

Laboratory assignments are given in eight groups (of two hours / week) for Database I and five groups (two hours /week) for Database II.

2.3 Scope, Goals and Objectives

The first activity tried to jointly develop a statement of scope. The determination of scope was tackled (seen) as a project management activity. The scope was defined by answering the following main questions:

What is the proper course from which to begin? What constraints are imposed?

What tangible results will be produced as output from the course?

How does the course to be built fit into a larger academic context?

Curricula of the Department of Informatics (Technological Education Institute of Athens) and the Department of Industrial Informatics (TEI of Kavala) were collected. The programs of these Departments are conforming to the ACM/IEEE curricula 2001 for Computer Science. Course’s title, type, semester, prerequisites, credits, aims and objectives, course contents, class requirements – grading, and recommended bibliography were captured and analyzed.

2.4 Main Decisions and Rationale

Two compulsory lessons of Databases are included in the curricula of the two Departments: ‘Database I’ (introductory), ‘Database II’ (advanced). An advance Database course was selected to serve as “the first system” of distance tutoring. Database I is a prerequisite lesson for Database II. The Department of Informatics,

TEI of Athens, has an elective lesson "Special Topics on Databases and Information Retrieval". The department of Industrial Informatics, TEI of Kavala, is currently in the course of revision of its curriculum. The department considers as critical, for its students, knowledge about:

Temporal DBs, essential for production systems applications,

Real time DBs, essential for robotics and control systems applications and

Main-memory DBs, essential for embedded systems and implementation of real time DBs.

These subjects will be included in an elective course "Data Bases III" in the 7th semester.

'Database I' covers various topics of an Introduction to Database technology, and is organized following the same way. It is compulsory, belongs in the 3^d (in the case of TEI of Athens) or 4^{th} (in the case of TEI of Kavala) semester, comprises theory and laboratory, the duration is 12 weeks, 4 hrs/wk and 5 ECTS credits are assigned.

The aim of the course in the case of the Department of Informatics is the following:

Explain the main concepts and characteristics that distinguish the database approach.

Cite the basic goals of a real Data Base system based on Case Studies

Illustrate the data base design concepts.

Objectives that the course covers:

The student learns how to design applications using ER-modeling, Normalization, etc.

The student learns how to implement data base applications using SQL/4GLs, Oracle.

In the case of the Department of Industrial Informatics the aim and the objectives are the following:

Compare and contrast information with data and knowledge.

Describe common information needs and try to configure the applications to cover them. Describe the main features that distinguish the database approach from the traditional approach of programming with data files.

Identify major DBMS functions and describe their role in a database system. Explain the concept of data independence and its importance in a database system.

Describe the basic principles of the relational data model, and define the fundamental relational model terms.

Illustrate the modeling concepts and notation of the relational data model and relational algebra.

Create a relational database schema in SQL that incorporates key, entity integrity, and referential integrity constraints.

Demonstrate data definition in SQL and retrieving information from a database using the SQL SELECT statement.

Evaluate a set of query processing strategies and select the optimal strategy.

3 Planning, and Directing the Reengineering Process

This activity obtains information necessary for detailed needs analysis, improves the understanding of the information domain, completes the revision of goals and objectives of the different courses, outlines the ways to meet common needs, conducts the preliminary description of resources, and specifies Constraints. Some instructional material development is also included. Preliminary capturing of assessment procedures and decisions related to the instructional strategies complete this phase.

It follows an interactive approach (brainstorming, interviews, questionnaires, discussion and evaluation of other systems etc) to define / specify / capture required function(s), functionality, behavior, performance, and interfacing. *Requirements are captured, documented and reviewed using a complex Tutor-Learner and Content-Instruction Centered Approach.*

A portion of collected data is depicted for the lesson Database II, which is compulsory for the Departments.

Aims & Objectives of the lesson (TEI of Athens)

Main

Students must learn how to design and implement complex database system and applications using new tools and techniques, in a competitive professional environment that keeps changing.

Others

Students study advanced topics and new techniques related to data base technology, applications design and implementation.

Students study and learn various topics of database administration.

Aims & Objectives of the lesson (TEI of Kavala)

Overview of normalization – higher normal forms. When to denormalize.

Database design from dependencies – limitations.

Describe the main concepts of the OO model such as object identity, type constructors, encapsulation, inheritance, polymorphism, and versioning.

The Object Relational DBMS.

The (Enhanced) Entity Relationship Data Model.

How to use the (E)ER model in the DB design process. Mapping to OO and Relational models.

How to embed SQL commands into a stand-alone language such as C++.

Describe what issues are specific to efficient transaction execution; commit and rollback a transaction. Explain the effect of different isolation levels on the concurrency control mechanisms and how to choose the proper isolation level when implementing a transaction protocol.

DBMS Administration: Recovery, Backup, Security.

Using DBs in Real Time applications. Main memory DBs.

Using DBs over the Internet (and Intranets). XML technology.

Collected data was analyzed and the convergence and approximation offered the possibility of the common curriculum of the course. The aim, the objectives and the content were supported for the two departments, in general. Only the following objective of the Department of Informatics was not supported by the distance course:

"Students study and learn various topics of database administration".

4 Design, Allocation and Units' Standardization

This task covers the general architecture and components of the course. The following components are specified: "Database Design" including six units ("lessons"), a "Case Study" and two assignments, "Database Programming" including three units ("lessons"), two "Case Studies" (PL/SQL, ORACLE Pro*C) and two assignments, and "Specific Themes and New Trends" including three units ("lessons") and an "Open discussion". Special emphasis is given to the modular design that ensures functional independence of the components and the units: Every Component (and Unit) could be taught independently. Instructional material for students is also prepared.

Detailed description of every unit ("lesson") for standardization is given. Decisions related to the specification and allocation of "Case Studies", assignments, and laboratory exercises are described. Content analysis, main topics, an outline of the Instruction and strategies are described for every unit, "case study", assignment. More precisely, the standardization process follows a linear sequential model including:

Criteria selection, Information (content) acquisition, Content Analysis which is the Analysis of the collected Instructional material, Specification of critical paths (and potential "bottle-necks") which is some kind of (lessons') plan, Detailed design and preparation of the unit, Review which is a first Evaluation of the standardizing process.

5 Workflow Process - Instruction

Experimentation with Distance Learning was conducted during the Autumn 2004 - 2005 semester. Database II lectures (units - "lessons") were organized to form three Components as we have already mentioned:

"Database Design" including six units ("lessons"), a "Case Study" and two assignments was mainly offered in a distance learning way. Especially, all the units were taught in a synchronous form. Some technical problems were encountered but communication was rather acceptable.

"Database Programming" including three units ("lessons"), two "Case Studies" (PL/SQL, ORACLE Pro*C) and two assignments were mainly taught by colleagues in Kavala.

"Specific Themes and New Trends" including three units ("lessons") and an "Open discussion" was offered by the tutor from the Department of Informatics (TEI of Athens) during a two days visit in Kavala.

It is worth to mention that this "personal", face-to-face contact in Kavala improved remarkably the evaluation (of the performance) of the course and the tutor by the students.

Laboratory exercises and assignments were also offered, mainly in a "local" basis (in Kavala).

The Distance course was offered, in a pilot basis, to all the students of the Department of Industrial Informatics (TEI of Kavala) according to the following principles, decisions and plan of activities:

The same course has to be offered for the traditional class in Athens, students of the Department of Informatics (TEI of Athens), and the "Distance" class in Kavala.

Kick off meeting: Tutor from TEI of Athens visited the TEI of Kavala to discuss the details, etc.

There are two tutors: One from TEI of Athens and another one from TEI of Kavala. There is also a tutor for some "Case Studies" and assignments in Kavala.

Two persons were working in Athens for the technical support of the synchronous distance learning and the preparation of some instructional material.

Two persons were working in Kavala for the technical support of the synchronous distance learning and the recording of the lectures, the organization and operation of a web-based dissemination scheme for the instructional material etc.

Six lectures ("lessons") were offered (by the tutor in Athens) following the scheme of the synchronous face-to-face distance learning.

The same lectures were given in the traditional class in Athens.

Accompanying material and all the communication between tutor and students were offered through e-mail and web.

Two Assignments were given. Solutions were submitted electronically.

An elective examination was given in Kavala.

Some evaluation was conducted.

Three lectures were offered (by the tutor in Kavala) related to Database Programming.

The same lectures were offered in the traditional class in Athens.

Other two Assignments were given. Solutions were submitted electronically.

Tutor from Athens visited Kavala and gave three lessons and an "Open Lecture and Discussion" related to new trends of Database and Information system technology.

The same lectures were offered in the traditional class in Athens.

Students in Kavala and Athens participated in the traditional final exams of the lab.

Students in Kavala and Athens participated in the traditional final exams. The Written tests were common for all the students just to compare the performance of the two classes. Tests are examined from the two tutors.

Evaluation of the course was conducted. Students in Kavala filled a questionnaire, anonymously, before to participate in the final examinations. The answers were collected by the secretary of the Department of Industrial Informatics and were sent to the tutor in Athens.

"Closed" discussion of the experiments. Evaluation and second thoughts for future use.

6 Evaluation and Feedback

This activity focuses on the planning, design of the course, tutoring, use of the web-based dissemination of instructional material. Evaluation based on the derived *Documentation* and the *Questionnaire* is the essential basis for any further analysis.

Documentation includes:

Detailed needs analysis and Review

Detailed outline of goals and objectives

Some Evaluation of the way(s) to meet needs

Final "architecture" of the course and detailed description of its components

Final resources' specification and related analysis

Final specified constraints

Instructional material

Evaluation of instructional material

Assessment procedures

Conclusions related to assessment procedures

Revisions and conclusions

Evaluation based on Questionnaire

Plan for final Revision

Summative evaluation (on-going at the moment)

The evaluation process is considered part of the overall experiment and was conducted on the basis of a questionnaire, covering all the aspects of the experiment, varying from the quality of the sound, technical clarity and expressiveness of the supporting material, average satisfaction from the distant based lesson etc. The results of the evaluation are presented in the following section and consist of the driving force towards our future activities.

7 Conclusions and Future Activities

The initial (preliminary) summative evaluation of the project (course), some additive evaluation based on the Questionnaire, the analysis and comparison of the final examinations in the two departments are interesting and promising for the future:

The experiments are very interesting for the students. It is a new concept for the majority of the Greek students and this fact has attracted their curiosity, interest and participation. The contact with more tutors, and the use of different ways of communication seems to be an advantage for such courses.

The evaluation of the tutor, from the department of Informatics, is positive. The personal contact has improved the results of the evaluation remarkably.

The evaluation of the course is positive, in general.

Technical quality of asynchronous distance learning is evaluated as “just about acceptable”

The Evaluation of the Instructional material is positive.

The evaluation of the Dissemination scheme is positive.

The results of the examination in Kavala are promising. Among the participants, 45% were passed. This percentage of success in the final examinations is related with a rise of 20% when we compare the results to the average number of students passed in the four previous semesters.

There is not any rise of the percentage of success in Athens.

The percentage of success in Athens is greater (more than 65%) than the success in Kavala.

A major problem encountered is related to the shortage of space in the Distance Learning class in Kavala. It is possible for only forty students to attend and there were more than eighty students in the traditional (ordinary) class during the visit of the tutor in Kavala.

Tutors share the opinion that distance learning can offer a basis for better understanding, qualitative co-operation and solutions to the problem of the lack of human

resources. Hence, an ongoing activity of the whole team is related to an in depth analysis of the derived documentation and the answers of the questionnaires. We think that useful conclusions will be extracted during the review of the following topics and the related documentation:

Requirements analysis, goals and objectives, ways to meet needs (instructional strategies, etc.), (courses) components, Resource analysis, units standardization, Constraints, Instructional material, Assessment procedures, Revisions, Summative evaluation.

There is also an ongoing activity related to the improvement of the available infrastructure, and the solution of technical problems. A preliminary study will be conducted in the near future to form a framework for new experiments and co-operation of the two departments in distance learning.

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