Exploiting Distance Learning Methods and Multimedia-enhanced instructional content to support IT Curricula in Greek Technological Educational Institutes

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Abstract

Greek Educational Institutes are lately confronted with many challenges. In order to face the difficulties arising due to the increasing number of students and the low ratio of teachers per student group, new distance learning technologies and strategies have been utilized and the development of multimedia instruction material has been introduced as a value adding practice in the educational process. In order to provide continuity to the experiment, the overall results have been recorded and a methodological framework has been established to support the combinatory use of distance learning techniques, based on a mixed COntent - INstruction, TUtor - LEarner and multimedia enhanced COntent DEployment centered (COIN-TULE-CODE) approach. Finally, evaluation of the learning experiments was conducted and interesting outcomes are discussed.

Keywords

Distance learning, Multimedia enhanced instruction, Instructional methodology.

Introduction

Various instructional strategies and material are at the disposal of the designers and tutors of online distance courses. However, in order to be effective, instructional interaction must exhibit some specific characteristics. Designers and tutors 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. They also have to be aware (during the stages of the design of an online, distance-course) of the theory and practice already established in the context of distance tutoring. Standardization of expected learning outcomes in computer science departments has been acknowledged by internationally recognized organizations such as the ACM or the IEEE. According to the ACM/IEEE Computing curricula (ACM/IEEE, 2001), "computer science students need to be able to develop conceptual and physical models, determine methods appropriate for providing efficient solutions to a given problem, and be able to select and implement appropriate solutions that reflect suitable constraints, including scalability and usability". The need for standardization and adoption of such principles has also emerged in the case of Greek Technological Education Institutes (Alevizos & Skourlas, 2004).

Multimedia support also arises as an interesting challenge in modern academic education schemes. An overall support of these principles, as well as the description and evaluation of a multimedia enhanced teaching methodology is presented in (Belsis et al., 2005; Alevizos et al., 2005). Kabourlazos et. al. (2004) have reported a low ratio of the permanent teaching staff in respect to the continuously growing number of students in the Informatics Departments in Greece. Furthermore, they mention that there is an ongoing explosive expansion of the Greek higher education, which has further aggravated the situation.

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Hence, the driving forces behind our efforts have been the need for standardization and co-operation, the limited time frame, and the lack of human teaching resources (Belsis et al., 2005; Rossiou & Pantziou, 2004). Unfortunately, traditional instructional design models generally tend to be linear, step by step guides directing the tutor through a series of necessary stages (Alevizos et al., 2005). Therefore, an "ambitious", non-prescriptive, combined Content – Instruction and Tutor - Learner Centred Approach (COIN_TULE) must be applied. The suggested approach is based on activities and task sets emerging from published research results and practitioners' experience about the natures of learning, instruction and the subject matter. More precisely, we try to explore, examine and capture the relationship between Content and Instruction (COIN–relationship, COntent-INstruction) and the relationship between Tutor and Learner (TULE-relationship, TUtor-LEarner). Such a work forms a basis for the extraction of useful characteristics that are incorporated into a methodological framework. The major advantage of this approach is that the Learner is put at the centre, which, not only improves understanding of the target audience, but also emphasises on the definition of course goals and learning objectives, the compilation of a detailed description of the content to be included, etc.

In the next sections we briefly discuss the following: Section 2 formulates the problem and describes the decisions which direct our choices. Section 3 explains the planning and design of our framework. It also presents the sub-tasks related with the framework in more detail. Section 4 concludes and presents directions for future work.

Problem Formulation

Traditional instructional design models have been often used for the development of instructional systems. Such models generally tend to be linear and tutor-centric, serving as step by step guides for tutors through a series of necessary stages. The methodology we propose puts the Learner at the centre of the design process, aiming at the enhancement of the tutor's and designer's understanding of their audience. A brief list of task set elements (items) which can be included in complex (mixed) tutor-learner and content-instruction centred requirement analysis activity, includes (Belsis et al., 2005): Understanding of the target audience (learner); the course goals of the project 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"; detailed description of the content to be included; outline of topics and subtopics to be covered; design and sequencing content of the course.

The resulting framework is influenced by the principles of the Software Engineering paradigm, which suggests a systematic, sequential approach that begins at the system level and progresses through analysis, design, coding, testing and maintenance (Belsis et al., 2005) and the Business Process Modelling approach. In every stage of this framework, and especially during the first ones, there is a need to work in three directions and conduct several related tasks, illustrated below.

Content and Instruction Centred tasks

Defining the content of a course is probably the most important task set of the need (requirements) analysis activity. It is also inter-related with the understanding of the scope and the needs that the course will cover. Hence, the designers / tutors from all the participating departments must have a close cooperation to specify at least the following: *Content Description*, *Outline of topics and subtopics* to be covered, *Design and sequencing content* of the course.

Tutor and Learner Centred tasks

Identifying the Learner is a major task related to the overall success of the project. Significant information about learners includes: Age, first enrolment date / semester, class; prerequisite modules (where applicable); other degrees, training, professional experience (useful for classifying the students, e.g. first class students, working students, students with special needs).

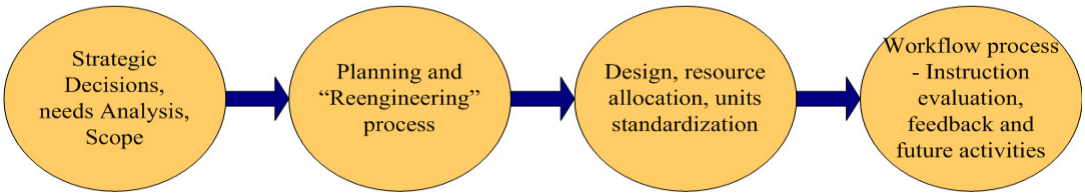

Figure 1: A business modelling based approach for instructional design.

Apart from the understanding of the target audience, the designers / tutors must answer questions as the following ones (Rossiou & Pantziou, 2004): What is the learner expected to learn? What should s/he be able to accomplish? How long should it take? They also have to specify detailed learning objectives.

Multimedia enhanced Content Deployment and related tasks

A number of different activities must be co-operatively conducted for developing the instructional multimedia title (material) and using the appropriate educational technology (Belsis et al., 2005). It is critical to try to capture: user requirements for specific target groups (learners) e.g. multimedia title for working students; goals and objectives of the multimedia title; system (title) components; constraints; instructional material to be covered; assessment procedures.

Problem Solution

In order to establish a co-operative framework for the distance learning course, we used the mixed COIN-TULE-CODE approach (figure 1). In this section, we analyse the ingredients of this approach, presenting some strategic decisions and results related to requirement analysis, the planning and "re-engineering" stage, the multimedia content deployment, and the "workflow process" (instruction).

Strategic Decisions, Requirements Analysis, Scope.

This stage focuses on the problem and the preliminary needs' analysis, examines various ways to meet the identified needs and, accordingly, conducts the appropriate cost-benefit analysis. Major milestones of this stage include:

IT-Labour Market Considerations

In a co-operative distance learning scheme Departments of Informatics should share the same thoughts related to the considerations of the Labour Market. Surveys on IT professional skills (Alevizos & Skourlas, 2004) revealed Database Technology expertise as "required" or "strongly recommended", making this subject a good starting point for experimentation on the design, development and delivery in the higher educational context.

Shortage of Resources and Other Constraints

The driving forces behind our efforts have been the limited time and human teaching resources; the low ratio of the permanent teaching staff in respect to the continuously growing number of students in the Informatics Departments in Greece (Belsis et al., 2005). In addition, an outgoing explosive expansion of the Greek higher education has further aggravated the situation (Kabourlazos et al., 2004). On this basis and in shortage of resources necessary to support teaching of specialized topics, we have made an attempt to support Databases instruction with alternative, technology-based methodologies.

Quantitative & Qualitative Data Collection

Data collected during traditional instruction of a subject matter can support the related decisions. For the Databases course case, the evaluation of instruction during the last four years in the collaborating TEI Informatics Departments has revealed major learning difficulty in database design and implementation issues (Alevizos & Skourlas, 2004). Hence, an emphasis should be given in these topics.

Scope, Goals and Objectives

The intention behind the first activity was the joint development of a statement of scope. The determination of scope was tackled (seen) as a project management activity. The scope was defined by answering the following questions (Rossiou & Pantziou, 2004): What is the proper course to begin with? What constraints are imposed? What tangible results will be produced as output of the course? How does the course under development fit into a larger academic context? For example, the curricula of both the Department of Informatics (Technological Education Institute - TEI of Athens) and the Department of Industrial Informatics (TEI of Kavala) were collected. The programmes of these Departments conform 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 analyzed and discussed to specify common scope, goals and objectives.

Main Decisions and Rationale

The curricula of both the aforementioned departments include two compulsory Database (DB) courses: 'Database I' (introductory), and 'Database II' (advanced). Database I is a prerequisite lesson for Database II. The advanced Database course was selected to serve as the first distance tutoring experimentation subject. The TEI of Athens has an optional course on "Special Database Topics and Information Retrieval". The department of Industrial Informatics, TEI of Kavala, is currently under a revision process of its curriculum, considering as critical the acquisition of 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 the optional "Data Bases III" course, in the 7th semester.

Planning, and Directing the "Reengineering" Process

During this stage the following tasks were conducted: detailed needs analysis, revision of goals and objectives of the different courses, ways to address common needs, preliminary description of resources, recording of additional constraints, experimental instructional material development, preliminary capturing of assessment procedures and decision-making concerning instructional strategies adoption.

Collected data were analyzed, while convergence and approximation offered the possibility of a common curriculum planning of the course. The aims and objectives of the course were identified as follows:

- Students should become competent in the design and implementation of complex database systems and applications using new tools and techniques, in a competitive and evolving professional environment.
- Students should be able to study advanced topics and new techniques related to data base technology, applications design and implementation.
- Students should be able to study various topics of database administration.

Design, Allocation and Units' Standardization

This stage covers the following tasks:

- "Architecture" of the course and detailed description of its components. Every, component is composed of units (lesson, case study, or assignment). 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 the students is also prepared.
- Detailed description of each unit
- Decisions related to the allocation of Case Studies, assignments, and laboratory exercises
- Standardization of units.

Content analysis, main topics, an outline of the instruction and the corresponding strategies are described for every lesson, case study, or assignment. More precisely, the standardization process (figure 2) follows a linear sequential model including: criteria selection, information (content) acquisition, content analysis specification of the critical learning paths (and potential "bottle-necks"), detailed design and preparation of the unit and review (an initial evaluation step of the standardization process).

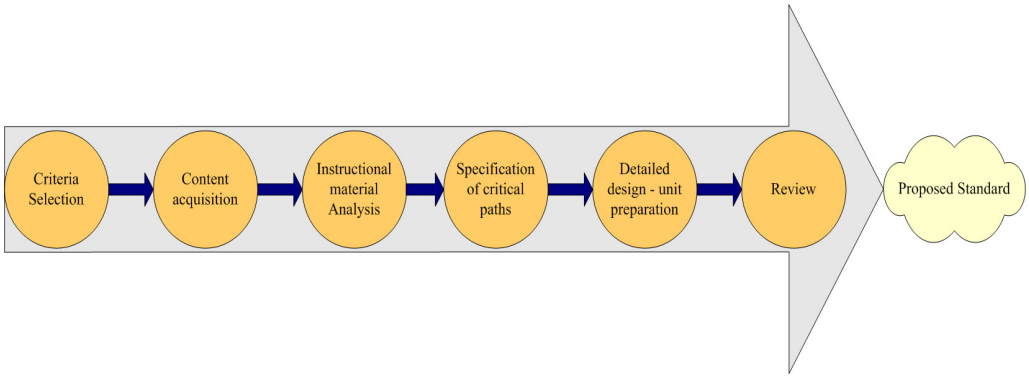

Figure 2: The standardization process that follows a linear sequential model.

A component example is the "Database Design" component, which includes six lessons, a case study and two assignments. Instructional multimedia material for students is also prepared during this stage. Special emphasis is given to the modular design, which ensures that every component and unit can be taught independently.

"Workflow" Process - Instruction

Distance Learning experimentation sessions were organized for both departments. Database II was structured to include three components, "Database Design", "Database Programming", "Specific Themes and New Trends" and an "Open discussion" session. The distance course was offered to the students of the Department of Industrial Informatics (TEI of Kavala) according to the following plan:

- A Tutor from TEI of Athens visited the TEI of Kavala to discuss the details, etc. Two persons in Athens provided technical support on the synchronous distance learning part and on the preparation of instructional material. Two persons in Kavala also provided technical support on the synchronous distance learning part, as well as the recording of lectures, the organization and operation of a web-based delivery platform for the instructional material, etc.
- The first component "Database Design" was composed of six lectures, which were given by the tutor in Athens. Synchronous face-to-face distance learning was used. Accompanying material and communication between tutor and the students were provided through e-mail and web.
- An optional examination was offered in Kavala.
- The second component "Database Programming" was composed of three lectures, which were given by the tutor in Kavala.
- A tutor from Athens visited Kavala and gave three lessons (comprising the third Component) and an "Open Lecture and Discussion" related to new trends of Database and Information systems technology.
- Students in Kavala and Athens participated in traditional final exams. The written tests were common for all the students, to enable comparison of the performance of the two classes. Tests were corrected by both of the tutors.
- Evaluation of the course was conducted. Students in Kavala filled an anonymous questionnaire, before participating in the final examinations. The answers were collected by the secretary of the Department of Industrial Informatics and were sent to Athens.

Evaluation Process

The evaluation process is considered part of the overall experiment. This activity focuses on the planning, design of the course, tutoring, use of the web-based delivery of instructional material. It was conducted on the basis of a questionnaire and additional documentation.
The documentation included: Detailed needs analysis and review, detailed outline of goals and objectives, evaluation of the method(s) to address identified 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 and Revisions and conclusions.

The questionnaire-based evaluation included a plan for final revising and summative evaluation. The aim was to cover all aspects of the experiment, ranging from the quality of sound, technical clarity and expressiveness of the supporting material to average satisfaction by the distance learning material, etc. The framework was also reviewed in the following directions: Requirements analysis, goals and objectives, methods to address identified needs (instructional strategies, etc.), (courses) components, resource analysis, units standardization, constraints, instructional material, assessment procedures, revisions, summative evaluation.

Evaluation Results – Feedback

As already mentioned the evaluation conducted focused on several aspects of the experiment, namely content adequacy, satisfaction of student's perception of aid received in both face-to-face and distance instruction, average satisfaction of video-conferencing as a synchronous instructional method. The results were very interesting and come in accordance with the expected, mainly showing that students were very satisfied by the new learning experience. However, their average opinion was that they gain more when the tutor is present and that sound quality problems or image instability encountered In LAN-transmissions, make the teacher's presence irreplaceable. According to students, traditional teaching could not be entirely substituted by technology-based methods.

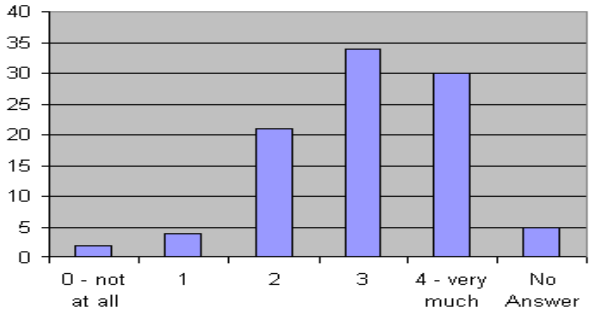

Figure 3: Theory and lab correlation.

In figure 3, the results show that students, in more than 75%, were satisfied by theory and lab correlation. This was mainly achieved through the careful design of the material provided, according to the theoretical framework's principles, so as to correspond to the preliminary needs analysis.

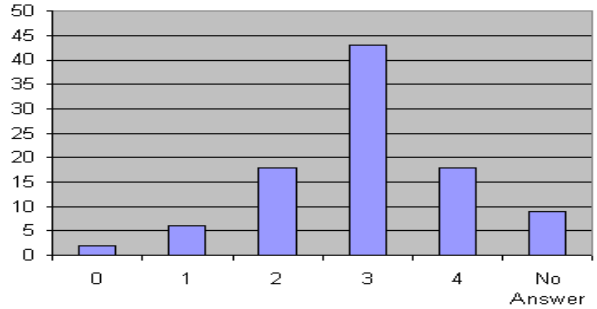

Figure 4: Distance in contrast with face-to-face tutoring satisfaction.

Figure 4 shows something very interesting and expected. Given a specific tutor, students' satisfaction grows considerably in cases of face-to-face instruction as opposed to distance instruction. However, there still remains the issue of whether this is due to the specific tutor's capabilities or this can be formulated as a general assumption. In order to test the validity of this hypothesis we plan to conduct more experiments for other thematic areas, utilizing different tutors.

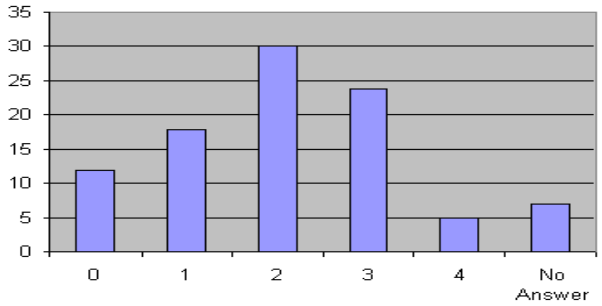

Figure 5: Average satisfaction on Video conferencing as an instructional method.

Figure 5 illustrates low average satisfaction in using video-conferencing (VC) as a single teaching method. This is expected; physical presence is of major importance, still VC can be an acceptable solution when face to face instruction cannot be applied (e.g. when no specialized teaching personnel is available). In addition, some remarks about the last observation relate to the quality of transmission which always depends on the available equipment. Our institutions utilized the University network for transmission, which, during working hours, was often overloaded, thus resulting in a decreased transmission quality. We believe that the upgrade of the equipment will result in higher average student satisfaction. We also have to mention that the size of the guest institute's classroom was not inadequate for the big number of attending students. This resulted in difficulties for students not occupying the front seats to listen attentively during the lesson.

Conclusion and Future Directions

"Choose always the way that seems best however rough it may be; custom will soon render it easy and agreeable", Pythagoras (582 BC – 507 BC), Greek Mathematician and Philosopher.

The major problem while planning, preparing and offering distance learning courses was the existing infrastructure. Firstly, there is a shortage of space in the Distance Learning class in Kavala and only forty students had the possibility to attend from eighty students enrolled. Secondly, technical quality of synchronous distance learning was evaluated as «just about acceptable». However, there is some promising estimation based on the following:

1 Tutors and supporting staff share the opinion that the proposed framework for distance learning can offer a basis for better understanding, qualitative co-operation and solutions to the problem of the lack of human resources.
2 Distance tutoring experiments as a new concept for the majority of the Greek students have attracted their interest and participation. The contact with more tutors and the use of different ways of communication seems to be an advantage for such courses.
3 The evaluation of the instructional multimedia material and the web based dissemination scheme is positive. Among the participants, a 76% responded that they between very and totally satisfied, while only 7% of the students were not adequately satisfied.

Among the main objectives of e-learning or technology-based instruction is to enhance the efficiency of teaching and provide visual aids both to the teacher and to the students. The main features of multimedia teaching include:

- Content accuracy: Several issues can be addressed by experts and captured in multimedia format in order to be utilized by teachers and students in the future.

- Constant availability: Certain topics can be accessed anytime-anywhere, without the need for physical presence of the tutor.

Building upon these main principles, our approach incorporates basic notions of computer science lessons design, providing basic knowledge from selected bibliography in text form, while the multimedia part of the content deployed in CD-ROM describes selected topics and presents the performance of high skill actions and the execution of complex commands on several computing platforms.

4 The evaluation of the tutor by 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.
5 The results of the examination in Kavala are better than "just acceptable". Among the participants, 45% passed. This percentage of success is related to a rise of 20% compared to the results in the four previous semesters.

The initial (preliminary) summative evaluation of the project (course), additional evaluation based on the questionnaire, the analysis and comparison of the final examination in the two departments are interesting and promising for the expansion of the experiments in the future. 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 this review. In addition, the improvement of the available infrastructure and the solution of technical problems are currently underway. Regarding the deployment of multimedia-enhanced content, we have so far developed material for teaching Databases and Parallel Systems courses. The evaluation process in a real educational setting proved more than promising, encouraging the involvement of the research and academic staff in a longer-term design and development instructional material process.

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