NEW TICS COURSES RE-DESIGN FOR TASK-BASED ORIENTATION

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We present at this article the development and re-design of two technical courses devoted to be part of a new European Master that will start-up this new course 2009/2010 in the Plovdiv University, in Bulgaria, to be later expanded to other Universities (as the UNED) that are partners of the European Project IPLECS (sponsored by the European initiative ERASMUS).

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1. Introduction

We present here the design and curricula of two new courses:

- Real Time and Industrial Communications, and
- Power Supply for TICs Equipment

that will be part of the new European Master "ICS – Information and Communication Systems" that will be firstly organized by the Plovdiv University to later be expanded to the rest of the partners Universities (UNED among them) [1].

2. Real Time and Industrial Communications

The course "Real Time and Industrial Communications" is devoted to provide the student the competences on Real time systems and programming allowing then the basic knowledge on communications oriented to industrial systems one of the evolving areas now in a high level of development. The application of industrial systems is a must in all applications of factory and industry automation where a literacy on communication (digital and analog), distributed systems and real time applications are fundamental for the delivery of solutions, together with the market orientation on Industrial Ethernet, fieldbuses and specific solutions.

In this course the student must show competencies regarding the capabilities of:

- Fundamentals on Real Time Systems.
- Programming on Real Time Systems.
- Real time Java as an open programming system.
- Ethernet based communications, IP and standards.
- Field buses and distribution processes.
- Basic approach to Profibus, Worldfip, CAN and Industrial Ethernet.
- Security and quality of service.
- Application areas of Industrial communications.

The student must be able to show evidence of competencies for the performance criteria (PC) showing at Table 1. Table 2 shows the development of the course having in mind the tasks developed as well as the tasks objectives.

Table 1. Performance Criteria for the course Real Time and Industrial Communications.

Performance Criterion	**Evidence Check: The student can demonstrate …**
PC1	Basic knowledge of real time systems and the main characteristics of the industrial communication systems regarding concepts as network integration, time and event synchronization, message scheduling and static and dynamic priorities scheduling.
PC2	Practice approach to programming on real time systems managing interruptions, communication inputs/outputs, synchronization and messages. Configuration and profile of personalization.
PC3	Practice approach to Java programming implementing real time systems.
PC4	Fundamentals and basics on communication issues as basic networks configuration and approaches, transmission and codification, protocols and data-link, OSI and TCP/IP standards, media access, LAN, WAN, PAN, IP networks and wireless systems applications.
PC5	Knowledge of field buses, distributed systems, message system, synchronization and configuration of those systems.
PC6	Knowledge of Profibus, Worldfip, CAN and Industrial Ethernet. Comparisons, applications, differences on applicability and market and industry orientations.
PC7	Recognition and implementation of security and quality parameters and techniques inside industrial communication systems.
PC8	Knowledge on application areas as: home, car, ship, flight and spatial systems; as well as control systems, instrumentation, sensors and actuators, SCADA systems.

Table 2. Modules and tasks development of Real Time and Industrial Communications.

MODULE	TASK	TASK OBJECTIVE
Fundamentals & Programming on Real Time Systems	Task1. Introduce fundamentals on real time system and mechanisms where are supported. Having in mind the programming of real time systems and specific relative issues. Evaluation: one open question regarding main strategies and real time system mechanisms and developing the analysis of personalization and specific manage of control issues and messages	Basic knowledge of real time systems and the main characteristics of the industrial communication systems regarding concepts as network integration, time and event synchronization, message scheduling and static and dynamic priorities scheduling. Practice approach to programming on real time systems managing interruptions, communication inputs/outputs, synchronization and messages. Configuration and profile of personalization
Real time Java as an open programming system	Task2. Real-time Java extensions. Implementation of real time systems in Java. Evaluation: 5 objective questions (4 selections only one correct) regarding programming issues in Java and real time specific questions on extension on real time	Practice approach to Java programming implementing real time systems
Ethernet based communications, IP and standards	Task3. Introduce fundamentals on Ethernet based communications including protocols, standards. Evaluation: 5 objective questions (4 selections only one correct) regarding protocols and standards Task4. Development of LAN, WAN, PAN and IP networks as well as wireless systems. Evaluation: one open question developing a summarized work about IP networks and importance in communications	Fundamentals and basics on communication issues as basic networks configuration and approaches, transmission and codification, protocols and data-link, OSI and TCP/IP standards, media access, LAN, WAN, PAN, IP networks and wireless systems applications
Field buses and distribution processes	Task5. Principles of field buses and distributed systems regarding main aspects on configuration and programming and messaging. Evaluation: one open question developing a summarized work of the synchronization and messaging implementation on field buses	Knowledge of field buses, distributed systems, message system, synchronization and configuration of those systems

Table 2. Modules and tasks development of Real Time and Industrial Communications (cont.).

MODULE	TASK	TASK OBJECTIVE
Basic approach to Profibus, Worldfip, CAN and Industrial Ethernet	Task6. Introduce fundamentals on Profibus, Worldfip, CAN and Industrial Ethernet with their basic characteristics and functionalities. Develop comparisons, applications, differences on applicability and market and industry orientations of the specified field buses. Evaluation: one open question regarding functions and properties of the specified field buses and developing a resume about an specific application of the specified field buses in an specified industrial environment	Knowledge of Profibus, Worldfip, CAN and Industrial Ethernet. Comparisons, applications, differences on applicability and market and industry orientations
Security and quality of service	Task7. Development of principles of security and quality parameters in industrial communication systems. Evaluation: 5 objective questions (4 selections only one correct) regarding aspects of the security issues and of the quality performing	Recognition and implementation of security and quality parameters and techniques inside industrial communication systems
Application areas of Industrial communications	Task8. Introduce other application areas of industrial communication systems and other control system applications. Evaluation: one open final question of new applications of industrial communications	Knowledge on application areas as: home, car, ship, flight and spatial systems; as well as control systems, instrumentation, sensors and actuators, SCADA systems

3. Power Supply for TICs Equipment

The course of Power Supply for TICs Equipment aims to provide the students a specific view of the needs that will manage in the future to cover the power supply requirements that will need any information and communication center to have a good functioning behavior. This course prepare the competences and knowledge for basic electrical issues together with the power supply specifications which will be used as inputs for the design of the power supply system that the student will analyze and model from the basic electronic equipments.

In this course the student must show competencies regarding the capabilities of:

- Power electronics based equipments for Information and Communications Systems.
- Basics on reliability and systems management.
- Electrical grid characteristics and critical load management.
- Voltage and line conditioners and Uninterruptible Power Systems.
- Environmental issues of Power Supply equipments.
- Safety issues of Power Supply equipments.
- Fundamentals of low power voltage and electrical installations.

The student must be able to show evidence of competencies for the performance criteria (PC) showing at table 3. Table 4 shows the development of the course having in mind the tasks developed as well as the tasks objectives.

Table 3. Performance Criteria for the course Power Supply for TICs Equipment

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Performance Criterion	**Evidence Check: The student can demonstrate …**
PC1	Ability to specify the needs of the ICS regarding power electronics and the possibilities of equipments to fill them.
PC2	Knowledge of reliability and quantitative analysis as well as basics and types of management applied to power electronics.
PC3	Use of knowledge applied to critical electrical loads and the different parameters regarding to electrical grid performance.
PC4	Ability to specify the use of different types of equipments like voltage and line conditioners or Uninterruptible Power Systems and to select one specific equipment fulfilling requirements.
PC5	Practical performance on building and room environment issues as well as in electrical and electromagnetic interferences.
PC6	Practical performance on safety handling Power Supply equipments.
PC7	Basic knowledge of low power voltage and electrical installations regarding the problem solving issues on direct and alternate (single and three phases) current.

Table 4. Modules and tasks development of Power Supply for TICs Equipment.

MODULE	TASK	TASK OBJECTIVE
Fundamentals of low power voltage and electrical installations	Task1. Introduce fundamentals on electrical based systems and electrical installations in low power voltage. Evaluation: 5 objective questions (4 selections only one correct) regarding direct and alternate (single and three phases) current and low power voltage and electrical installations	Basic knowledge of low power voltage and electrical installations regarding the problem solving issues on direct and alternate (single and three phases) current
Power electronics based equipments for Information and Communications Systems	Task2. Introduce requirements of the ICS equipments regarding power consumption and electronics and different equipment to perform them. Evaluation: one open question developing comparisons on the specifications and fulfilling on power equipments for ICS	Ability to specify the needs of the ICS regarding power electronics and the possibilities of equipments to fill them
Basics on reliability and systems management	Task3. Development of concepts on reliability and quantitative analysis applied to management on power electronics systems. Evaluation: 5 objective questions (4 selections only one correct) about concepts on reliability and quantitative analysis	Knowledge of reliability and quantitative analysis as well as basics and types of management applied to power electronics
Electrical grid characteristics and critical load management	Task4. Presentation on critical electrical loads parameters and needs and electrical grid performance. Evaluation: 5 objective questions (4 selections only one correct) regarding importance on parameters on critical electrical loads and electrical grid performance	Use of knowledge applied to critical electrical loads and the different parameters regarding to electrical grid performance

Table 4. Modules and tasks development of Power Supply for TICs Equipment (cont).

MODULE	TASK	TASK OBJECTIVE
Voltage and line conditioners and Uninterruptible Power Systems	Task5. Basic introduction on line conditioning, UPSs and storage systems applied to ICS. Parameters selection and delivering on UPS. Evaluation: one open question regarding power equipments to improve line characteristics and conditioning on ICS and developing a summarized work about selection of an UPS for an specified ICS	Ability to specify the use of different types of equipments like voltage and line conditioners or Uninterruptible Power Systems and to select one specific equipment fulfilling requirements
Environmental issues of Power Supply equipments	Task6. Presenting the building and room environment issues oriented to practical problems and solutions. Evaluation: 5 objective questions (4 selections only one correct) regarding specifications on the building and room environment of electrical equipments Task 7. Principles of electrical and electromagnetic interferences regarding electrical equipments. Evaluation: 5 objective questions (4 selections only one correct) regarding interferences of electrical equipments	Practical performance on building and room environment issues as well as in electrical and electromagnetic interferences
Safety issues of Power Supply equipments	Task8. Presentation of practical performance on safety concerns about handling Power Supply equipments. Evaluation: one open final summary about electrical room designing having as objective the safety concerning issues	Practical performance on safety handling Power Supply equipments

4. Design Criteria

For developing courses materials, UNED teachers have worked on the adaptation of existing materials and media in the traditional UNED methodology, to task-based environments and competences acquisition, in accordance with the EHEA methodology.

There is a common Workflow Model for all courses in European Master "ICS – Information and Communication Systems" which is represented in Figure 1.

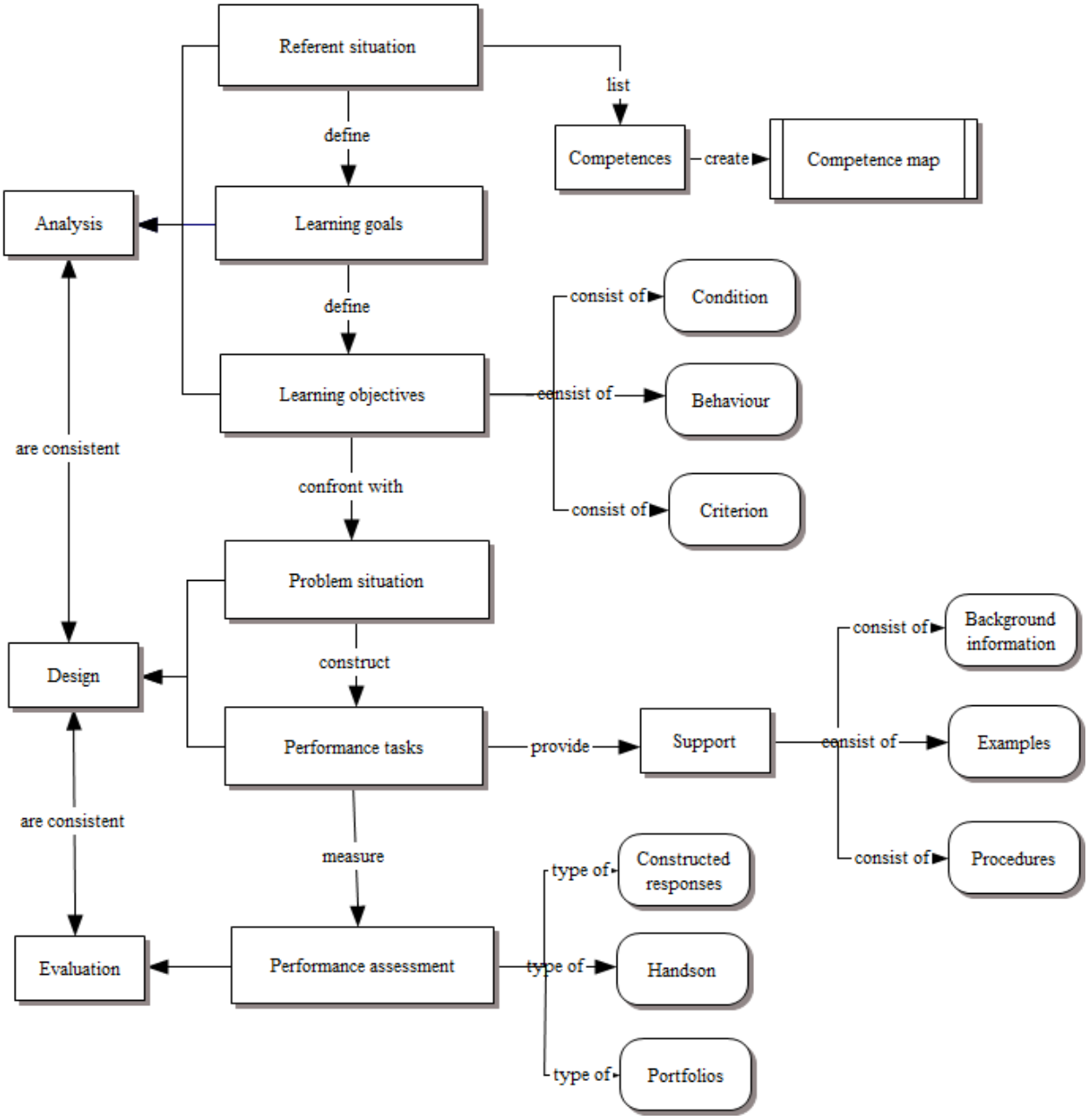

Figure 1. ICS Curriculum Workflow Model

There is also a common Instructional Design for Performance-centered E-learning course which defines Modules and Tasks formats.

4. 1. Modules Design

All modules in a course are designed according to the same format. In this way students are always provided with all necessary information and students can find the information always in the same place.

Each module consists of the following elements

- *Introduction to the module*
  A short introduction explaining the topic, the context, its relation to performance in the later profession. The module objectives are described broadly, explaining for example the level of the course (i.e., introductory, deepening, more focusing), it's relation to other courses, and what the student will be able to do after following the course.
- *Objectives of the module*
  A set of learning objectives will be defined, indicating the main goals of the module and what skills, knowledge and attitudes the student will develop during the module.
- *Required prior knowledge for the module*
  For each module it will be indicated what prior knowledge or skills are required in order to successfully follow the module. A distinction can be made between necessary and recommended prior knowledge.
- *Overview of learning tasks*
  For each learning task the title, number and a list of learning objectives must be provided.
- *Syllabus*
  An overview of all obligatory and recommended resources relevant for the learning tasks of the module.
- *Calendar*
  An overview of the chronology of assignment deadlines and other important events relevant for the module.

4. 2. Tasks Design

Each learning task consists of the following elements (Fig.2):

- *Introduction to the task*
  A short introduction is provided explaining the goal of the tasks, the relation of the task to other tasks in the module etc.
- *Description of the task*
  The learning tasks is described, explaining the students what is expected of them.
- *Learning objectives of the learning task*
  For each task a set of learning objectives and performance standards are defined. The learning objectives provide a description of what the student will learn by performing the learning task.

  The learning objectives are described in terms of skills, knowledge, attitude and context.

  The description consists of a verb, an object and required equipment, conditions under which the behavior needs to be shown and performance standards that are a description of the quality requirements of the result.

- *Resources (obligatory and elective)*
  Task relevant resources support students by making immediately available information, which they either have to study or use just in time to perform the task. The reference section allows the student to be better prepared for a given task because it is always available to the student and provides the theory behind the task it supports both on forehand and just in time.
- *Instructions how to perform the task*
  Worked-out solutions to problems using key task concepts. Additional materials and examples.
- *Task-specific training*
  Theory behind the task; specific for each task Task-specific training reduces preliminary training by helping the user to learn while performing the task. This type of training is learner-controlled because the learner asks for help when he needs it to perform a task, and the help gives him the specific information that (s)he requests.
- *Expert advice about the task*
  If the student encounters a problem he can consult an expert for advice. Expert advices part contains specific advice on performing tasks. The advice is usually provided by an expert system.

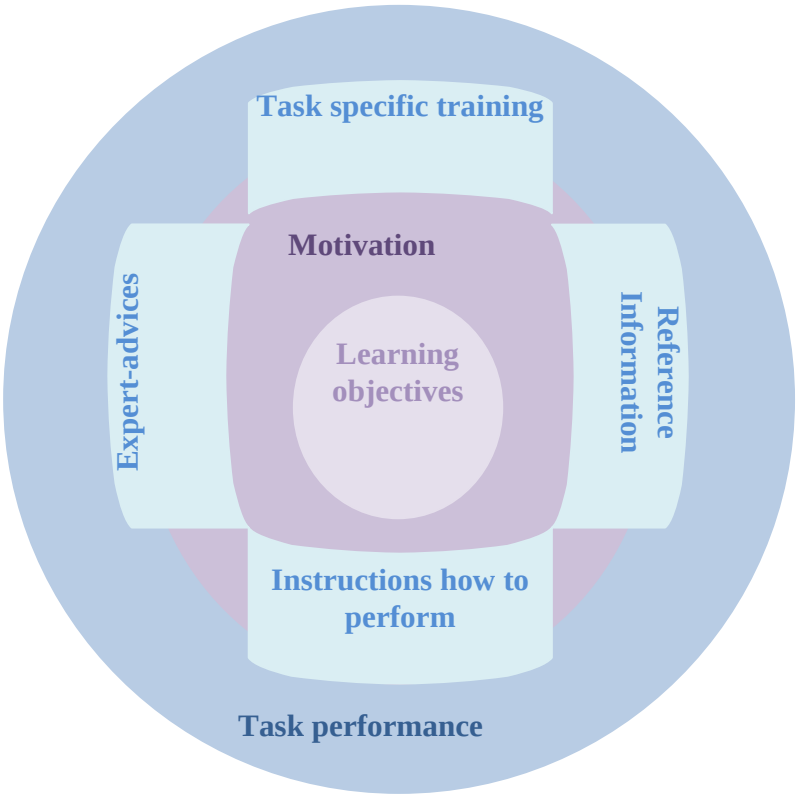

Figure 2. Schematic overview of learning task structure

The performance support system for learning is provided mainly in the following elements

- Instructions how to perform the task.
- Task-specific training.
- Expert advice about the task

Some tips for content presentation for these main elements are:

- *Task-specific training.*
  - Information is organized into small, stand-alone units. Each unit should be independent. Students–performers who are using this Instructional Design should not have to read earlier information to understand current information.
  - Audio, video, or text-based content with graphical information
  - Graphical presentation of the tasks in gif, jpg files.
  - Tools using - Internet, MS Office and Adobe Acrobat applications

- *Instructions how to perform*
  - Instructor worked out examples or solutions to problems
  - If your lecture is text-based, consider appropriate places to include graphics to add interest and multiple representations of the content. If your audience has high-speed Internet access, consider recording and streaming brief video presentations. For students with low-bandwidth, make video presentations available on a CD.
  - Include at least one example for each type of problem that the student will be asked to solve.

- *Expert advices*
  - Identify symptoms, problems and possible solutions for all critical situations and trouble shootings
  - Target: Between 1 and 5 per task.

5. Conclusions

We present in this contribution a new re-design of two courses for a new European Master devoted to Information and Communication Systems following a competences and task-oriented principles. This two courses will be organized during the 2009/2010 academic year.

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