Multi-media "DFM" course for design of electronic modules/micro-systems

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Abstract: *The objective of this paper is to present a multi-media Design For Manufacturing (DFM) course developed in our university and to emphasize the importance of such interactive courses in relationship with other forms of instruction as students expect today to receive more individualized training. Multi-media instruction offers multiple benefits to education, including a wide range of instructional options and, with adequate instructional design, considerable reduction of the learning time, the time of expert teachers, and when large numbers of students are involved, the cost of learning. The multi-media "DFM" course for design of electronic modules/micro-systems is part of an European project, Elect2eat (E-learning Education and Continuing Training to Electronics Assembling Technology), which is a public, multi-lingual training system [3]. Another European project, mSysTech (E-Training Microsystems Technologies), starts from this multi-media "DFM" course, being focused on the transfer of innovation in the field of micro-systems in Romania and Bulgaria. Its main objective is adapting and implementing the e-learning environment with training materials based on simulations and demonstrations to improve skills in micro-systems technology [4].*

1. INTRODUCTION

Multi-media learning is defined as learning from words (from spoken or printed text) and pictures (illustrations, photos, maps, graphs, animation, or video). Multi-media environments include on-line instructional presentations, interactive lessons, e-courses, simulation games, virtual reality, and computer-supported in-class presentations [1]. Learning is constructive and information learned is remembered at a deeper level. The use of multi-media promotes meaningful learning that can be transferred or generalized to other situations.

Holding the attention of the student and engaging the user's mind is necessary for learning to occur. Interactivity makes the difference between a program that simply presents information and one that actually trains the user. Today's learning processes can be summarized in seven points [2]:

1. from linear toward hypermedia;

2. from instruction toward construction and discovery;

3. from teacher focused education toward student focused education;

4. from learning through material absorption toward learning how to find things out and how to learn;

5. from learning at school toward global learning that lasts the whole life;

6. from one way of learning which is the same for everyone toward an adaptable way of learning;

7. from learning as a torture toward learning as fun;

Msystech (figure 1 – the starting page of the website) and Elect2eat (figure 2 - the starting page of the DFM course) projects offer a new approach of thinking for the vocational learning process - learning for knowledge work and its presentation system, as a performance-centered task-oriented educational

system. Both are two-year projects within the European program Leonardo da Vinci and the partners are from small and medium enterprises (SME) in packaging and micro-systems, training organizations and universities from various European countries, as Hungary, Romania, Bulgaria, Slovakia, Sweden, France and Germany.

Fig. 1. Starting page of the MSYSTECH project website.

The projects are aimed to implementation of an innovative approach for performance–centered learning and development of new instruments in instructional design of task-performance-centered courses for vocational education in electronic packaging and micro-systems, approach defined in a previous European project as Internet-based Performance Centered Instruction (IPCI).

Fig. 2. Starting page of the ELECT2EAT program.

2. THE APPROACH

Learning technologists must recognize that their jobs do not end with training. Learning must be turned into performance, shared with the entire organization, then cycled back into the next iteration of training. Learning technologists must take an interest in - if not responsibility for- the full cycle. They need to embed performance support and knowledge sharing into learning activities so they become second nature to the learners/performers. In the past the main focus was oriented on learning or knowledge transfer rather than performance results in people who know what to do but never do it [6].

So, in our project we have decided not just to design an improved training but to perform a performance-centered design. The performance-centered design transforms knowledge into performance by creating an interface to the knowledge base. In the design we followed the principles, determined by Rosenberg [7].

Performance-Centered Design - is the key difference between performance support systems and training systems. In training systems, the author takes the role of expert and sets the rules for working and the criteria for success. In a performance support system, we must recognize the performer's expertise in his/her environment and the fact that the performer may have additional information not contained within or considered by the support system. Our system developed in these two projects, therefore, takes the role of a scientific assistant rather than a director [8].

Learn by doing - much of what we know to do in a job we learn on the job. One of the responses of the training community has been to provide just-in-time training or on-demand learning, so as to situate the training in the job environment at the time of need. This direction has a great merit and no doubt will benefit development of work competencies, but we consider that the greatest limitation of training is its abstractness. Merely changing the time and place will not make it contextually appropriate. Our learning and support systems need to increasingly model apprenticeships rather than simply serve as information distribution systems [8], [9].

Apprenticeships embed the learning of skills in their social and functional context and make the "what is learned" more meaningful and valuable. A performance support system should encourage workers to try things that stretch their knowledge and skills.

Organizational Memory - refers to the knowledge that an organization has or could have about its business and to the process it uses to acquire and

recall that knowledge. It includes what is archived in electronic and paper documents, but even more critically, what people are doing at their work for learning. Often people are in a situation when they need to know something and instead of studying books or other archives they call someone.

Our support systems should aspire to mimic the knowledge base and process for acquiring expertise that is used by practitioners. Thus, the process needs to be on-going, rooted in practice and experience, and constantly adjusted by new inputs. We need to find ways to capture and share expertise. So, in the reported IPSS the knowledge base is the core component.

Technology Use - the performance support system (PSS) is a natural extension of building technologies that transform the way people work and learn. The technologies of performance support help people be connected when they are mobile, be competent when they are inexperienced, be reflective when they are hurried, and be resourceful when they are challenged. Our systems, developed in Msystech and Elect2eat, are fully Web-based.

In Elect2eat, for example, the transferred innovative content mostly appears in the form of tangible products:

The e-learning program, where the Design for Manufacturing module is included, is the most important domain of the Electronics Assembling Technology environment. This module is a specific web-cast with free navigation possibility, and access to written and oral explanations, animations and videos, a photo library, self-assessment possibility etc.

The Assessment Tool is a new initiative to use the self-assessment method of “definition matching quiz” and “picture matching quiz” of the e-learning program to examine the knowledge of the trainee. It is believed and by the university education it has been proved that web-based training systems have short-term impact on both convergence education (retraining of already graduated professionals/ engineers to a new area) and continuing education (training for field professionals/engineers according to their employer/industry needs). Figure 3 presents partially the structure of the DFM multi-media course and its training modules.

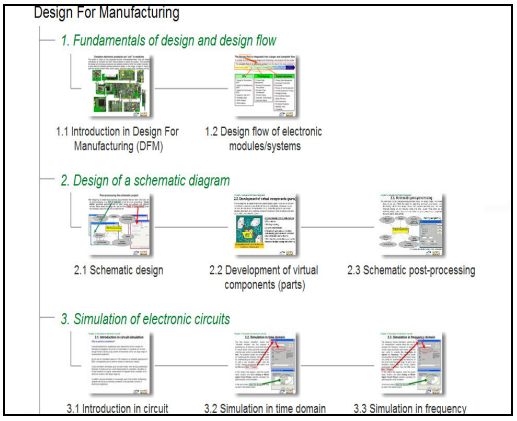

Fig. 3. The structure of the DFM multi-media course (partial picture).

3. TEACHING COURSES

3.1. Introduction in Design for Manufacturing

Our lives are being revolutionized by electronics. The ways we work, communicate, shop, bank, travel, and learn are changing radically. And whereas natural resources, labor, and capital once determined a nation's wealth, today technology - in aerospace, computers, telecommunications, and consumer electronics - significantly affects a nation's wealth and security. Miniaturization of existing products will place libraries and supercomputers into our briefcases. The range of future opportunities is bounded only by the ability of our industries to utilize these new capabilities in developing next-generation products.

The packaging of electronic devices and micro-systems represents a significant challenge for product designers and managers. Electronic packaging continues to include expanding and evolving topics and technologies, as the demands for smaller, faster, and lighter products continues without signs of abatement. These demands mean that individuals in each of the specialty areas involved in electronics packaging, such as electronic, mechanical, and thermal designers and manufacturing and test engineers, are all interdependent on each others knowledge.

The design of high-quality products is based on a new concept named Design For Manufacturing (DFM), which is a complex process of performing conception, design and post-processing activities

focused to the real manufacturing (and not done only as simple artworks). Practically, DFM is a process integrating manufacturing and optimization principles into the earliest stages when designing and developing the electronic products.

Today, the design flow of any electronic product is always based on the fundamental set of acronyms CAE-CAD-CAM (Computer Aided Engineering - Computer Aided Design - Computer Aided Manufacturing), which define practically all the development stages during the conception, design, manufacturing and testing of electronic modules/micro-systems.

3.2. Electronic packaging

In the past, the term "electronic packaging" referred to a small number of formats for encasing electronic components, including integrated circuits, so they could readily and reliably be installed in electronic end-products. The principal package types were through hole, surface mount, tape automated bonding, single-chip, and multichip, and also packaging configurations like dual in-line packages (DIP), small in-line packages (SIP), and quad flat packages (QFP).

The electronic package is the structure used to interconnect, power, cool, and protect the integrated circuits (ICs) of electronic systems and products. To optimize the IC performance, the package must provide:

- high electrical performance (i.e., less delay, low noise etc.);

- high packaging density => miniaturization;

- low power consumption;

- high reliability.

4. MULTIMEDIA TEACHING ENVIRONMENT

The Msystech and Elect2eat e-learning systems support:

• participants in the acquisition and the use of knowledge, skills and qualifications to facilitate personal development, employability and participation in the labor market Europe-wide;

• universities, training centers, vocational education schools, institutions, associations, enterprises in providing high quality, innovative e-learning courses and practices through the web;

• the enhancement of the attractiveness of vocational education and training;

• the mobility of employers and individuals as well as of working trainees.

The e-learning provision of these two projects will help the participants to be integrated into the mainstream education and training in the electronics and micro-electronics field. The distance and multi-lingual learning features of both systems will help to eliminate all forms of discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation.

When the users access the training programs ([3], [4]) the starting page of the e-learning programs appears, offering all the information necessary to begin the study. There are available the following courses: Design for Manufacturing, Components and Printed Circuit Boards and Assembling Technologies (Elect2eat) and Design and Technology of Micro-systems, Packaging Technologies, Photo-masks and Photo-lithography and Thermal Management of Micro-systems (Msystech).

Each module of the above courses is a specific web-cast with free navigation possibility, and access to more written and oral explanations, movies and videos, a photo library, a glossary, self-assessment possibility, and additional links to other resources in the field of electronics and micro-systems.

5. CONCLUSIONS

Most European countries are working towards a more technologically driven school system in which students are provided with more individualized learning, better Internet and computer skills, and increased interactivity both within their countries and around the world. The extent to which this is happening across Europe is largely contingent on the availability of resources and the level of commitment of both governments and partners from the private sector.

Multimedia courses may be chosen over other forms of instruction because students expect that they will receive more individualized instructor contact. Multimedia instruction offers extraordinary benefits to education, including a wide range of instructional options and, with adequate instructional design, considerable reductions in the time required to learn, the time of professors, and, when large numbers of students are involved, the cost of learning. Like all new and exciting educational innovations it also suffers from mistaken beliefs about its potential and achievements.

In this paper we have presented a work in progress within the two European projects, "E-learning Education and Continuing Training to Electronics Assembling Technology" and "e-Training Microsystems Technologies". The projects are aimed at implementation of innovative approaches for performance–centred learning and development of new instruments in instructional design of task-performance-centred courses for training in micro-systems. As a new technology, Elect2eat and Msystech will move the traditional teaching systems to the closely related to the job learning. In this point, these systems have a strong potential to help students mastering job-related skills. The message to professors and instructors is to take into consideration the impact of this new approach for teaching oriented to practical results, good performance and competitiveness, approach which offers another perspective of modern learning.

As happens with most new technologies, some people will promote this approach as the answer to all problems. But like most technologies, it has its limitations. If the improvement in employee's performance in companies is already proved, for the students there are some doubts and we have to study the effectiveness of this approach in the university context and framework. We expect to learn more about the effectiveness of this new approach through the experiments planned during the future pilot tests and practical implementation at university under-graduate level.

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