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COLLABORATIVE LEARNING CONCEPT FOR LIFELONG LEARNING

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***Abstract**: Most of the articles published in the last years highlight teaching and learning approaches and technologies integrated in complex applications and present the concepts used for educational content creation and delivery. They refer to the approaches and methodologies used in self and collaborative learning, including problem- and project-based learning. The proposal is focused on advanced concepts for improving the online training services and how a generic framework can be customized for lifelong learning, effective recruitment techniques and virtual consultancy. The paper underlines the Web 2.0 concept and its application to non-formal and informal learning, especially virtual training, career development, or online tuition. The article is based on a virtual collaboration prototype that supports interpersonal collaboration and advanced human-computer interaction. It complies with a cloud-based open architecture adapted to the requirements of a generic collaborative/interactive learning infrastructure and the manner it can be customized for different business domains. It also illustrates how Computer-Supported Collaborative Training (CSCT) tools improve the knowledge building process and which solutions should be adopted for avoiding the CSCT weaknesses. The generic framework for Computer Supported Collaborative Training presented in the article should fix a set of issues we met during our training/tuition activities: problems with the training staff, time management, responsibilities during the training process, human-system interaction, content management, and cost effectiveness.*

***Keywords:** collaborative training, lifelong learning, cloud computing, virtual consultancy*

I. INTRODUCTION

Lifelong learning (LLL) has been at the centre of many national education reforms in the past decade and higher education policy has been considerably shaped by it. At a policy level, a simple, elegant vision of integration and mutual dependence between learners, industry and higher education institutions (HEIs) need special attention. This way, study programmes at HEIs are aligned to industry's skills and knowledge requirements and learners actively select and pursue educational opportunities in order to make and keep themselves employable. [2]

Training and career development, as special forms of LLL, consists of complex activities that promotes in a crossed way the learning of knowledge in the cognitive domain, as well as skills in the psychomotor domain. Nevertheless, when it involves groups or learners, the scope of knowledge building expands to the relational/social domain. Consequently, the instructional-design theories and models used in the training process represent a fundamental factor for the development of shared cognitive schemes that can improve the teamwork. [1]

The changing nature of work and study under knowledge-based economy of this century constrains the teachers and students to adopt new methods of dealing with complex issues that require new kind of knowledge. They need to work, collaborate and learn new things from a variety of resources and people, to investigate questions and bring their learning back to their dynamic learning communities. The number of learning communities grows up but just some of them have the expected success. [6] Often the virtual collaboration tools focus on a specific solution or collaboration task only, without considering the integration of this process into a large but easy to use and very suggestive environment. Moreover, the collaboration technologies require a change in human interaction. Thus the uptake is mainly driven by the benefit. If users do not experience an immediate personal benefit new applications are not applied even if the new tools are properly introduced.

This paper describes a powerful framework that provides with computer supported collaborative training capabilities and the manners it can be customized for different business domains such as engineering, medicine, sales, banking or insurances. After a suggestive introduction, the related works and proposals are presented in Section II. Section III illustrates the hybrid cloud environment for online training, its open architecture, as well as the most important aspects regarding the implementation of a generic CSCT framework and its deployment on the cloud computing environment. Several important aspects are taken into consideration: how to improve the retention factor during the self-study, how to provide remote access to equipment, digital resources and applications and how to support industrial research and experimental development activities within individual, group-based projects or international partnerships. The experimental results included in SECTION IV highlight the implementation of the hybrid cloud for online training and its applications to different domains such as engineering, medicine (medical imaging), banking or insurances. In conclusions, the authors underline the importance of cloud-based collaborative frameworks for virtual consultancy and training programmes and presents a laborious scenario for extending such complex approaches in different domains such as medicine or financial institutes.

II. RELATED WORKS

Several approaches have been identified as solutions to online training issues. They implement advanced methodologies and involve powerful technologies such as virtual reality (VR), serious games, augmented reality (AR) or collaborative tools. The virtual reality elements help the learner to easily transpose in the virtual environment for telepresence, simulation work and interaction. VR implements the e-bridge concept that fixes the e-gap problems between the virtual environment and the real world where the trainees do their job and learn. AR helps the lecturer to annotate complex educational materials or live demonstrations by adding new elements or hide existing ones in order to increase the training effectiveness.

Gandelman [10] presents a proposal for training content design based on stories exposed by professionals within the organization, and therefore, expressing the application of concepts in practice, promoting the organizational learning. The proposed method have been assessed from the training content production point of view. The exploratory study was accomplished in a non profitable organization, responsible by the Brazilian Academic Network. The central theme was the annual budget elaboration. The evaluation scenario includes a face-to-face mode: one participant acted as reviewer and also as coordinator, two other acted as the collaborators´ group. The coordinator/reviewer explained to the group the concepts of storytelling, group storytelling and context. The group was also introduced to the method and its steps. Finally, it was also explained the exploratory study goals. The method helps to build a story whose focus is the good story elements and a good training story. The proposal highlights the content relevance, since it is based on organizational real tasks through contextualized stories.

Li [9] divided the research into three parts including document reviews, in-depth interviews and focus group methods to find out the training needs of the research and development (R&D) staff. Firstly the authors have reviewed the business plans and annul R&D plans. The aim was to identify the training needs. Secondly, they used in-deep interviews with several R&D project managers to collect

the important training requirements. Finally, the authors applied creative problem solving technique on Group Decision Supporting System (GDSS) with an important part of R&D staff to identify the employee training expectations. They proposed an innovation-oriented training program for R&D staff, which conducted cross-industry learning community to develop new production and defined the training transfer strategy.

Aguilar [1] proposes a Team Training Strategy (TTS), which involves the use of an Intelligent Collaborative Virtual Environment (ICVE) that assists the small groups during the training process. It consists of the Collaborative Virtual Environment (CVE), which allows the human tutor to coordinate the virtual meetings of the group, and the Intelligent Virtual Environment for Training (IVET) that assists the group during the execution stage. TTS includes four interrelated stages: *integration* of human team by using the CVE components, *execution* of planned task based on IVET components and assisted by PVA, *evaluation* process of team members where CVE will be used by the human tutor in order to identify both individual an group errors, then by the team members for iteratively reproducing and analyzing the previous plan execution, and the *improvement* stage when the team will gave the possibility to re-plan the assigned activities.

III. COMPLEX IT INFRASTRUCTURE FOR LIFELONG LEARNING

The paper highlights the importance of the collaborative technologies in online training platforms: virtual assistance, human-computer interaction, video conferencing, online focus group, virtual shared space, media streaming or video capture/recording functionalities. We propose a prototype based on a hybrid architecture, illustrated in Figure 1, that extends the LAMP stack and complies with the advantages of SOA (Service Oriented Architecture).

3.1. Generic framework for online training. Architecture.

The framework architecture consists of the following blocks: Apache web server, MySQL database server, OSFlash Red5 media server, OpenOffice 2.0, GostScript, MEncoder libraries. It provides integration functionalities and allows the developers to externalize the media services (Influxis, e.g.) or storage capabilities (virtual library). Apache web server hosts the web components that implement the generic training functionalities such as authentication, or web access; MySQL database server stores the information regarding the lecturers, trainees, training resources, courses, exams, certifications, skills or competences to be achieved. [11]

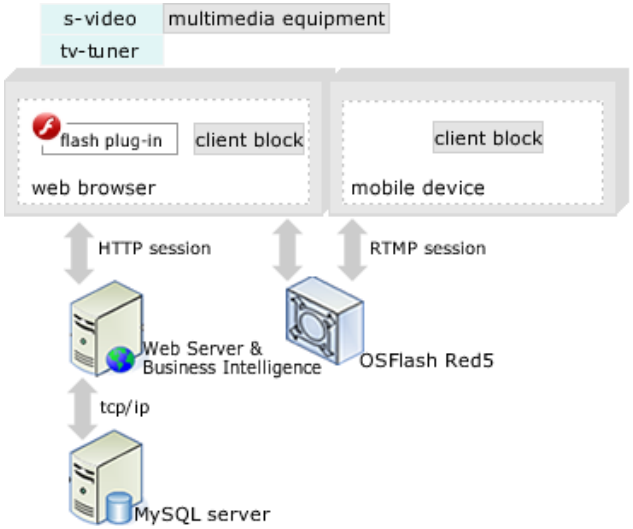

Figure 1. Generic framework architecture

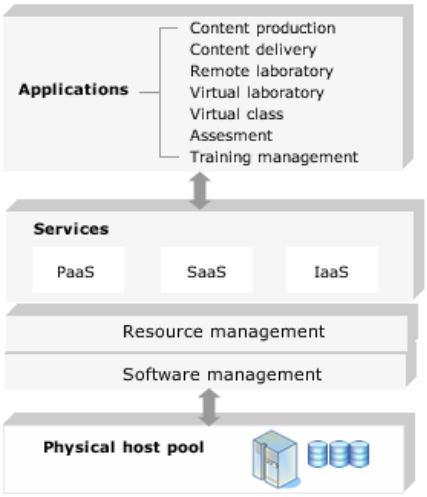

Figure 2. Hybrid cloud architecture

Red5 media server provides with video conferencing capabilities, media streaming and video capture/recording functionalities, as well as remote shared objects support. The training resources

should be converted from original formats to .pdf and slideshow before being stored into the virtual library. The conversion block is a Java-based components that uses OpenOffice 2.0 and GostScript libraries for converting MS formats or pdf files to slideshow and MEncoder for converting the multimedia files into .flv, mp3, or mp4 formats. This way, the virtual library supports most of the file formats and the *service handler* component can manage the digital content in an unified manner.

The architecture also contains a set of intelligent components able to implement advanced functionality. The *Business intelligence* block consists of a multi-agent platform that deals with actors' behaviors and elaborate statistics, analytics reports, or scenarios based on activity tracking. Another set of intelligent agents dynamically allocate the hardware and software resources needed for the training activities: equipment, applications, interactive materials, or simulation packages. The training sessions, usually considered as a part of the job, are conducted by qualified personnel and scheduled by team leads or heads of departments, with the scope to allow trainees to achieve knowledge and skills related to the activities and tasks they need to accomplish during the further projects. In order to enhance the training process, the study schedule of each learner will be handled by the own virtual assistant, an intelligent component that implements the multimodal interface concept.

3.2. Hybrid cloud for computer supported collaborative training

The CSCT framework provides with (a)synchronous virtual collaboration and contains a set of components dedicated to the online training activities: user management block, virtual library, search engine, statistics module, electronic agenda, project management module, virtual shared space, multimedia messaging, forum, virtual assistance, videoconferencing tool, online focus group, etc.

In order to simplify the development process, the framework components will be divided in four main categories: *generic components*, *interpersonal collaboration components*, *interactive components*, and *inter-process collaborative components*. The generic components implement the main functionalities such as database management, user management, statistics and electronic schedule. Interpersonal collaborative components enable lecturers and trainees to actively participate to online training sessions based on advanced instruments such as multimedia messaging, forum, virtual shared space, videoconference, online focus group, video/screen recorder or webcasting. The interactive components, such as search engine, virtual library or project management tools, allow the end-users to control and interact with the system by using the natural language. Inter-process collaborative components are intelligent components such as business intelligence and virtual assistant that permit the developer to automate the collaborative process in a transparent manner.

The generic framework have been deployed on a cloud computing architecture, illustrated in Figure 2. A hybrid collaborative cloud prototype has been accomplished. It can be divided into the following layers: hardware resource layer as a dynamic and scalable physical host pool, software resource layer that offers a unified interface for e-learning developers, resource management layer that achieves loose coupling of software and hardware resources, service layer containing three levels of services: software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS), application layer that provides with content production and delivery, remote and virtual laboratory, virtual class, assessment and management features. SaaS is used to deliver applications to trainee's browser from the hybrid cloud. It helps companies with limited IT resources to deploy and maintain needed software in a timely manner while, at the same time, reducing energy consumption and expenses. PaaS facilitates development and deployment of applications such as laboratory simulation software packages without cost and complexity of buying and managing the underlying infrastructure (hardware and associated software). IaaS gets on-demand computer infrastructure, from a simple virtual desktop to a rack or whole data center.

IV. EXPERIMENTAL RESULTS

The prototype has been implemented on *HPMCloud infrastructure*, as a horizontally and vertically scalable collaborative environment. The main objective was to enable organizations and training companies to focus on training process management, as well as content creation and delivery,

then benefit by managed services while a specialized team takes care of IT system construction, maintenance, platform development and management. The approach has been tested in *engineering*, especially *software development, electrical engineering*, *applied electronics, or telecommunications* but the same scenario can be implemented in *medicine* or *financial* domains.

One of the *Electrical Engineering Laboratories* within the *Technical University of Cluj-Napoca* provides *E-On* and *Electrica*, two of the most important companies in Romania, with research, consultancy and training services in optimization of transmission and delivery components. The companies experienced different problems and proposed a long term cooperation agreement. In order to identify the issues, the teaching staff decided to used Mathcad, Matlab and Mathematica software packages. The distance and tight schedule constrained the parts to use a virtual environment for fixing the problem, as well as personnel training for the employees responsible of implementing the proposed solution.

Each company has allocated the own virtual platform for consultancy and training that provides with virtual laboratory, virtual library, interactive tutorial and webinar capabilities. The virtual laboratory allows the teaching staff from the Technical University of Cluj-Napoca to remotely access the laboratory equipment and applications the company provides with, accomplish the tasks and save the work on the lab section within the virtual library. The virtual library offers remote access to the training resources, materials or references, as well as storage features. The interactive tutorial components enable teachers to record parts or entire laboratory tasks and convert them in interactive training content. The webinar allows teachers to schedule and conduct face-to-face training sessions, or invite employees from the company, as well as young colleagues from the university to attend the real-time exposure.

Due to data security and integrity issues, the teaching staff must perform the modeling tasks within the virtual platform, by using the remote laboratory tools. The software packages such as Mathematica, Matlab, or Mathcad will be lunched within a virtual machine accessible by teachers via web browser. The end-user can remotely control the software packages, accomplish the own tasks and save the work on the virtual machine, then send a message to the partnership coordinator about progress. At the end of each project phase the teaching staff can schedule training sessions that consist of the ample survey of theories applied during the modeling process, the presentation of tasks performed and the implementation scenario of achieved results.

Analogue, a Romanian software company plans to implement a *multimedia hub* that provides with high definition (HD) capabilities. The company already developed several web conferencing tools that offer SD quality, as well as video sharing web sites. High definition is a challenge and the implementation process is tight. This way the management board decides to opt for consultancy and training services from a specialized department focused on data capture optimization, audio/video compression, transmission and rendering.

The university department allocates a team of specialists with a strong background in multimedia technologies. The team members initially completed a survey in multimedia technologies, including media server implementations, existing APIs, advanced data capture, audio/video encoding and decoding standards, recording and storage or communication protocols. The report is also used as basics for the training content, the teaching staff conducted several online training sessions with software developers, as well as Q&A engineers to be involved. The teaching staff scheduled training sessions for the following topics: web conferencing tools, web TV and mobile multimedia. The subjects include audio/video data capture, implementation of advanced encoding standards and communication protocol, HD rendering, audio/video recording, multimedia storage or concurrent access to huge amount of data, and integration of television equipment. At the end of the training stage, the university specialists provided the company with the implementation scenario and two different technologies to be taken into consideration, as well as several optimization algorithms for data capture, audio/video encoding, multimedia transmissions, audio/video decoding, HD rendering.

The approach can be implemented in *medicine* or *financial* domains. For example, a medical university from European Union is involved in a training programme with medical staff from a hospital in Astana, Kazakhstan. The hospital has been purchasing an expensive advanced medical equipment and has no trained personnel for using it. This way, the European university decided to provide virtual assistance. The online training include webinars and interactive tutorials. The webinars

allow the teaching staff to schedule and conduct face to face training sessions, present educational materials in an interactive manner, collect questions and opinions, as well as share ideas and concepts among the online class. A *financial organization* also opted for managed services instead of setting up the own online training platform and involving personnel for design, implementation and maintenance. The management board has taken into consideration the company needs, the number of lectures, the number of trainees and the fields of interests and opt for a collaborative training setup that provides with virtual library, interactive tutorial, webinar, online focus group, video/screen recording, or video streaming capabilities.

V. CONCLUSIONS

This paper describes a powerful framework that provides with computer supported collaborative training capabilities and the manners it can be customized for different business domains such as engineering, medicine, banking or insurances. The paper highlights the importance of the collaborative technologies in online consultancy and training platforms: virtual assistance, human-computer interaction, video conferencing, online focus group, virtual shared space, media streaming or video capture/recording functionalities. We propose a generic framework based on a hybrid architecture that extends the LAMP stack and complies with the advantages of SOA. Its components are divided in four main categories: *generic components*, *interpersonal collaboration components*, *interactive components*, and *inter-process collaborative components*. The generic components implement the main functionalities such as database management, user management, statistics and electronic schedule. Interpersonal collaborative components enable lecturers and trainees to actively participate to online training sessions based on advanced instruments such as multimedia messaging, forum, virtual shared space, videoconference, online focus group, video/screen recorder or video streaming. The interactive components such as search engine, virtual library or project management tools, allow the end-users to control and interact with the system by using the natural language. Inter-process collaborative components are intelligent components such as business intelligence and virtual assistant that permit the developer to automate the collaborative process in a transparent manner.

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