DISTRIBUTED INTERNET - BASED PERFORMANCE - CENTERED ARCHITECTURE FOR LEARNING AND DEVELOPMENT

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The focus of this work is on Internet based electronic performance support systems with educational elements IPSS-EE (http://www.ipss-ee.net) and in particular, systems, which enable performance support environment to be distributed across computer networks.

The proposed DIPSS_EE architecture facilitates the cooperation among educational resources and systems, which are located in different geographical locations in different local servers. The main purpose of the work presented is to define the structure, model and the architecture of DIPSS-EE as well the technologies needed inside for the practical implementation of DIPSS-EE. The described new architecture is based on Communication Server implementing distributed database storage system that provides data and file replication in an environment of high data mobility and heterogeneous host capabilities. The use of web based Learning objects repository in the Communication Server enables the interoperability between the distributed nodes of DIPSS-EE.

In the DIPSS-EE multiple users can interact with distributed educational content in real time, and furthermore it is distributed, running on several servers which are connected by a computer network using a series of client server applications. DIPSS-EE has many characteristics that can be exploited in the educational process and especially in electronics education.

Keywords: Performance Support Systems, e-Learning, Individualized Learning, Distributed Data Management System, Learning objects repository

1. INTRODUCTION

The technological landscape of modern E-Learning is dominated by so-called learning management systems (LMS) such as Blackboard, WebCT or Moodle. Learning management systems are powerful integrated systems that support a number of activities performed by teachers and students during the e-Learning process.

Internet-based Performance Support Systems with Educational Elements (IPSS_EE) is an innovative approach for task-performance independent e-Learning and development of new instruments in instructional design of Internet-based courses for engineering education. (http://www.ipss-ee.net)

Internet-based Performance Support System with Educational Elements (IPSS_EE) is an integrated electronic environment, which is available via Internet and is structured to provide individualized online access to the full range of information, guidance, advice, data, images, tools and software to permit the user to perform a task.[1] The performance-centered approach offers new opportunities for the educational and training organizations and calls principle changes in the

instructional design of course materials. Developed IPSS_EE Environment gives up the course designers and teachers a possibility to create IPSS_EE courses without knowing the theory and organisation behind performance-centered approach [2]

Internet-based performance support system (IPSS) is one of the most advanced concepts in the domain of the educational e-Learning initiatives. It is aimed at providing just in time, just enough and the point of need support to learners in order to deal with complex authentic tasks in the context of problem-based learning. However the existing performance support systems solutions are short in exploring fully the advantages of Internet in managing distributed pedagogical resources in the most effective and efficient way. For enabling successful collaboration among educators, researchers and students allocated in different geographical regions is needed a new distributed performance-centered architecture for learning and development.

1.1   DISTRIBUTED PERFORMANCE CENTERED ARCHITECTURE FOR LEARNING AND DEVELOPMENT

A distributed Internet based performance support system with educational elements (DIPSS_EE) is defined as an integrated and globally accessible collection of one or more performance support systems containing electronic knowledge bases, tools and aids that can be used (as and when required) at a particular point of need (by an individual user or a workgroup) in order to improve human performance within a given job/task domain.

In the Distributed Performance-Centered Architecture (DPCA) multiple users can interact with distributed educational content in real time, and furthermore it is distributed, running on several servers which are connected by a computer network using a series of client server applications.DPCA have many characteristics that can be exploited in the educational process and especially in distance learning. Distributed learning enables students to get structured support in term of background information, examples, demos, simulations, procedures, and software from distributed sources with no time and place constraints. Distributed IPSS_EE introduces the concept of distribute instruction as well. It applies embedded content management facilities with tools, templates, and guidelines for designing courses from learning objects in a shared learning objects repository. DPCA enables instructors, developers, and learners to become consumers of, and contributors to a network of learning resources. DPCA enables individuals to collect and manage learning objects, perhaps creating portfolios of their personal learning experiences to reduce the transience of the e-Learning experience.

For the creation of a DIPSS_EE we have developed Distributed Performance-Centered Architecture of the system based on web services, automatic data replication system and software agents.[4,5]

DCPA enables users:

- To participate in Knowledge Communities

- To communicate with experts in a given field
- To exchange Learning Resources
- To work together on the production of Educational Material: Textbooks, lecture notes, case studies, simulations, etc.
- To deliver distributed Educational Activities: lectures, courses, workshops, case study discussions, etc.
- To distribute electronic content under license

The Distributed Performance-Centered Architecture (Fig.1) consists of one or more local IPSS_EE servers with the corresponding server side software, connected with a unified communication server, via the Internet communication environment for allocation of the educational resources and creating of a unified database repository and contents of the certain courses, maintained in the communication server. These are the main characterizations of the DPCA:

- The local IPSS_EE servers are independent of one another. They contain educational courses created from learning objects according to various scientific subjects.
- The local IPSS_EE servers can be geographically allocated worldwide.
- A learning objects repository and database of all educational courses is maintained in the communication server by replication of the databases of local servers, as well as the contents of the courses by replication of content files.
- The distributing environment for the databases replication and content files is Internet.
- The operational systems of the separate local IPSS_EE servers can be heterorganic (Linux, Solaris, Windows and others).
- In the communication server is running special designed replication and communication system, for content retrieval, login service, student records exchange service, IPSS_EE skill assessment portal, test manager, authoring service, ontology services and software agent platform all realized as web services.
- The communication protocol between the web services is Simple Object Access protocol (SOAP) running over HTTP, as well special designed protocol for data and file replication between databases of the local IPSS_EE servers and communication server.
- The replication system, synchronization and transfer of files and learning objects are completely automatic.
- The software of the system for the distributed databases management is independent, regarding its platform.

The distributed Internet based performance-centered architecture is aimed at coordinating all learning related activities and the management of learning materials. The PC of a learner interacts directly with the DCPA during a learning session. All Web services of the DCPA should also be accessible via Web pages, so that the learner only needs a Web browser to utilize the DCPA.

In a first step the learner has to authenticate in the DCPA, which is done by a DCPA *login service*. This service draws on a database with access rights and uses an preliminary defined authentication mechanism.
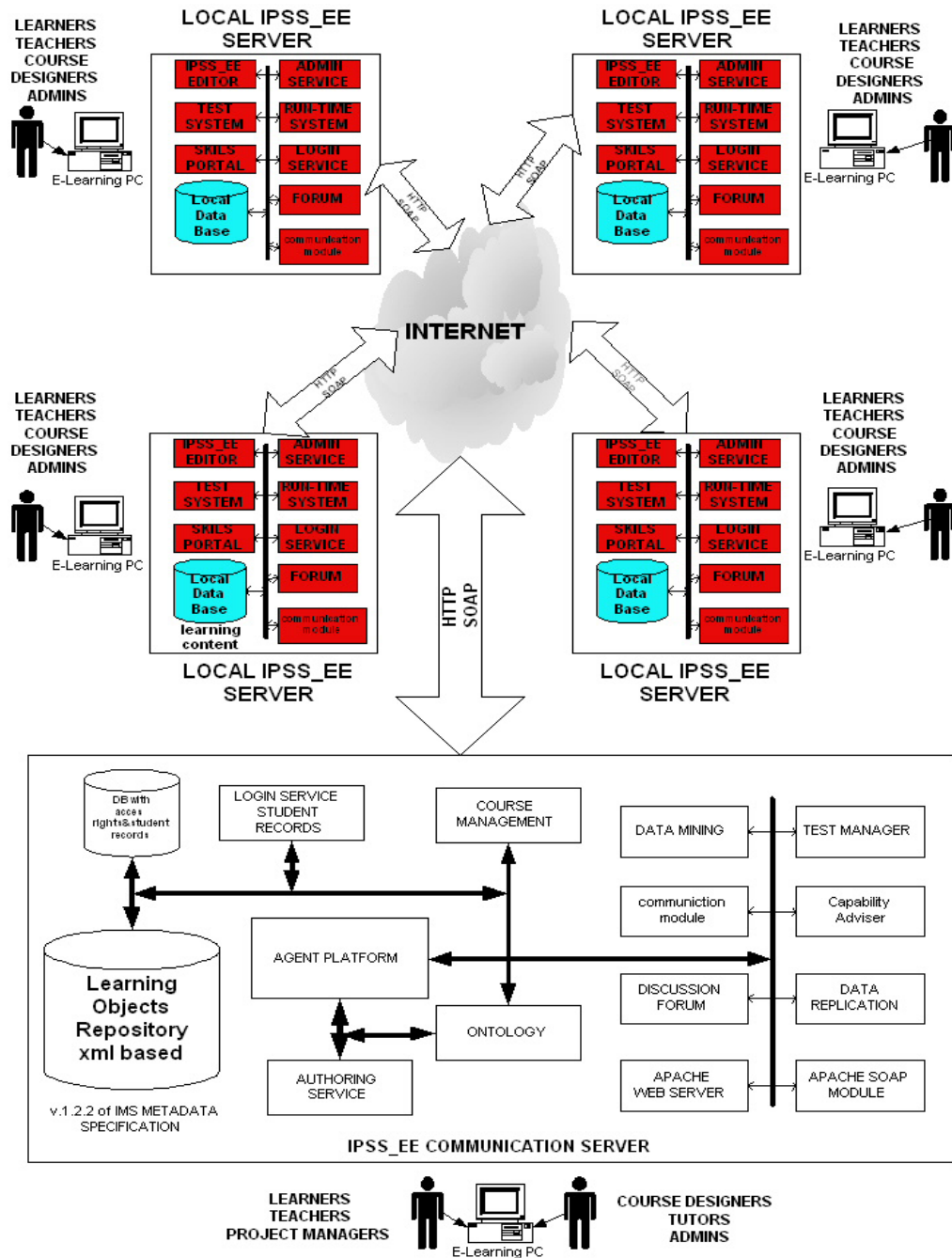

Fig.1 Distributed Internet based Performance-Centered Architecture

When the learner is logged in and authenticated, he or she can access a Web page for course management, the functionality of which is implemented in a *course management service*. The learner can look for suitable courses with ontology service operation, which searches for learning objects and courses with the help of the agent

platform, also implemented as a Web service.An *ontology service* support the semantic search for courses. It basically contains an ontology defining semantic relationships between Web services that provide learning objects. In addition, entries can be added to the ontology to support semantic retrieval of content. The DCPA also comprise other services like web based learning objects repository supporting v.1.2.2

Fig.2 Web-based Learning Objects Repository interface, running in communication server

of IMS Metadata specification (Fig.2). An *communication module* manages all processes which are related to retrieval, distribution and content replication between the IPSS_EE server nodes and the communication server.

The *agent platform* is an environment, in which software agents can be executed to retrieve LOs, and which is wrapped by aWeb service. Agents are intended to assist learners with the focused search for LOs, according to the specifications they made. The search parameters of an agent, the start of a search, or the access to the list of

retrieved LOs, for example, can be controlled by invoking appropriate Web service operations which extract metadata from LOs.

IPSS_EE Skills assessment portal provides Capability adviser where the skills of learners are assessed, already gained skills are recognized and for the skill gaps a learning plan is established.[8]

The Data Mining service analyzes web users' surfing behavior which gives to the designers of the architecture useful data for further investigations and development.

1.2   **CONCLUSION**

This paper presents a distributed, service-oriented Internet based performance-centered architecture for learning and development.As an enabling technology, Web services are used as wrappers around reusable granules of learning content (i.e., learning objects, LOs), as well as around modules of the presented architecture (e.g., course management, authoring, etc.). Web-service- LOs come in one package with content and functions which can extract, manipulate, or present learning content. For the distributed retrieval of LOs, agents, which are able to query metadata inside Web services, are used for personalized searches according to user specifications.

Our vision is that a LCMS need no longer be a single system residing on one server, but *a collection of distributed services* which may be offered by different vendors in different parts of the world. We expect this architecture to have several advantages compared to current practice, like better interoperability, scalability, and simpler extensibility.

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