

Knowledge-on-Demand in e-Learning and e-Working Settings

Demetrios Sampson
Charalampos Karagiannidis

Informatics and Telematics Institute
Centre for Research and Technology – Hellas
1, Kyvernidou Street, Thessaloniki, GR-54639 Greece

Tel.: +30-31-868324

Fax: +30-31-868324

sampson@iti.gr

karagian@iti.gr

Andrea Schenone

Fabrizio Cardinali

GIUNTI Interactive Labs S.r.l.
via al Ponte Calvi, 3/15, 16124 Genoa, Italy

Tel: +39-010-2465178

Fax: +39-010-2465179

a.schenone@giuntilabs.com

f.cardinali@giuntilabs.com

ABSTRACT

In this paper we briefly discuss the knowledge-on-demand (KOD) paradigm as it emerges from the current needs of the knowledge-based society. Basic requirements for on-demand learning are presented: anyone, anytime, anywhere delivery of education and training, adapted to the specific requirements and preferences of each individual citizen within different e-learning and e-working settings. Our work towards a feasible technical solution to support the KOD concept is also outlined.

Keywords

Adaptive learning material, on-demand learning, personalised learning

Introduction

The emergence of the knowledge society and the knowledge-based economy signify a new era for education and training. In the traditional economy, the physical capital and material resources have been the driving force, whereas, the new economy is driven by human/intellectual capital and knowledge. As computer-based systems tend to take over the linear, repetitive functions that 20th century workers used to perform, the new economy workers are expected to focus on problem-solving and critical thinking tasks (Hartley, 2000). Furthermore, rigid organisational structures are gradually replaced by adaptive, semi-autonomous, virtual organisations that rely on decentralised responsibilities and expertise - “learning organisations” which aim to attain success through the ability to learn faster than their competitors (Senge, 1990).

Within this framework, knowledge and skills of citizens are becoming increasingly important both for the economical strength and social cohesion of the society, and the quality of citizens’ life. The structural and functional society transformations raise the demand for major reforms in education and training, aiming at reducing the risks for knowledge gaps and social exclusion.

An interesting political and scientific debate is continuing about the paradigm shifts in the way that education and training is planned, organised and delivered, as well as the definition of concrete future objectives of educational systems. Typical demands include (Sampson, 2001):

- personalised training schemes tailored to the learner’s objectives, background, style and needs;
- flexible access to lifelong learning as a continual process, rather than a distinct event;
- just-in-time training delivery;
- new learning models for efficient integration of training on workplaces; and,
- cost effective methods for meeting training needs of globally distributed workforce.

The above trends call for a new paradigm for education and training, which goes beyond traditional practice, encompassing creative and critical thinking, communication skills, the ability to find information, as well as the ability to interact with others and so on. In this context, the importance of flexible, personalised life-long

learning is widely acknowledged. Personalised learning takes a learner-centred approach to education, advocating that it is the learning environment that should be adapted to the learner, rather than the opposite. The individual learner is responsible for his/her own self-directed, life-long education and training, and technology is used to effectively assist to this end. Under this perspective, a new paradigm of on-demand learning emerges, where the “anyone, anytime, anywhere” delivery of education and training is adapted to the specific requirements and preferences of each individual citizen within different e-learning and e-working settings.

This paper outlines some of the requirements for on-demand learning, in terms of the two broad user categories involved in this context: people interested in accessing learning material, applications and services within different e-learning and e-working settings, and people interested in authoring and publishing learning material, or providing e-learning applications and services. The paper also outlines a set of typical tasks that are necessary for supporting on-demand learning, as well as our work for developing the enabling technology to meet these requirements.

The User Groups

The objective of our work is to contribute in relation to the increasing requirements for on-demand learning. That is, the demand for easy access to high-quality learning material and e-learning applications and services within different e-learning and e-working settings, in a personalised way; as well as the supply of on-demand learning material and e-learning applications and services (European Commission, 2000).

In this context, our work addresses two main broad categories of users (see figure 1).

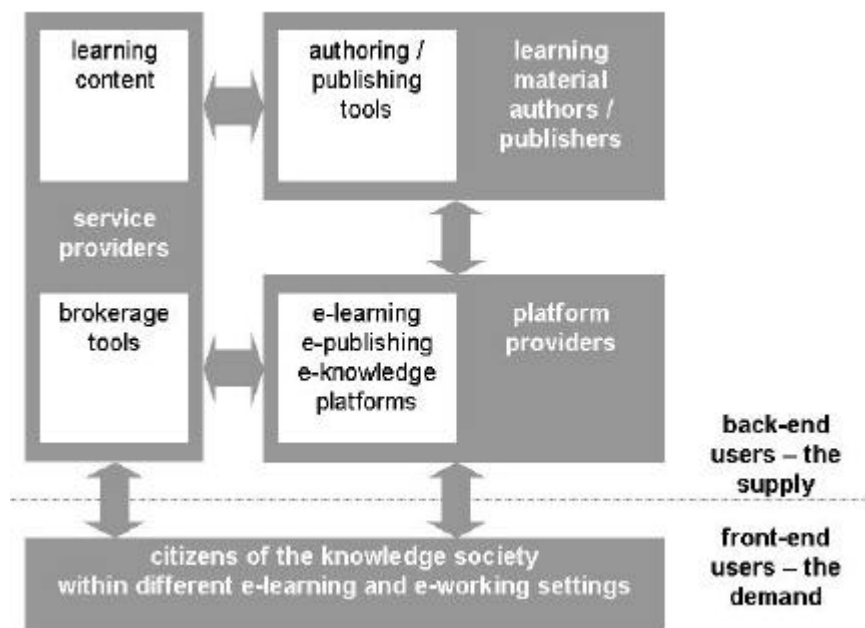


Figure 1. E-learning users

Front-End Users

Citizens of the knowledge society, interested in accessing learning material and/or e-learning applications and services, from internal (to their organisation, community, etc) and external knowledge repositories, within different contexts of use. Front-end users include:

- formal learners, accessing learning material within formal learning settings (schools, universities, etc), usually curricular-based and learning institution-mediated;
- vocational learners or workers with a strong motivation to improve their career development opportunities within a highly competitive environment, mainly interested in accessing knowledge and real-time assistance from their workplace, at the time and place that it is needed to complete certain tasks;

- life-long learners, who access knowledge repositories mainly in non-formal settings (e.g., learning at home); and,
- occasional learners, who access learning material “on the fly”, usually without a clear learning plan and objective.

Front-end users require efficient, effective, just-in-time and context-sensitive access to learning material and/or e-learning applications and services, anytime and anywhere, in a personalised way, according to their individual (and continuously changing) needs, requirements, preferences, skills, background, and so on.

Back-End Users

Individuals or organisations interested in publishing learning material, or providing e-learning applications and services. Back-end users may have different roles, business interests, and so on:

- authors and publishers, aiming to publish their learning material so that it can be easily searched and retrieved by individual front-end users through e-learning applications and services;
- e-learning platform providers, mainly interested in developing and providing applications which exploit available learning material, such as learning management systems, assessment systems, knowledge management systems, performance support systems, etc; and,
- e-learning service providers, using their own or third party learning material and platforms, to provide e-learning broker services.

Back-end users require tools that can enable them to meet the requirements of front-end users for on-demand, personalised learning within different e-learning and e-working settings. Moreover, they require tools which can enable them to author and publish learning material and provide e-learning applications and services in an *interoperable* and *re-usable* way.

Typical Tasks

Following the identification of the groups of users and the analysis of their needs, we have defined a set of high-level typical tasks that should be available for front- and back-end users for supporting on-demand learning. The scenarios for front-end users and back-end users are presented in Figure 2 and Figure 3, respectively, and are briefly described below.

Front-End Users

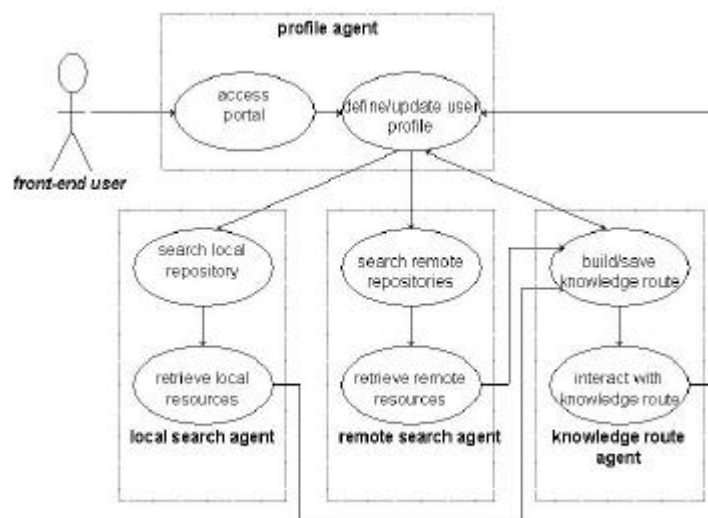


Figure 2. Typical tasks for front-end users

Front-end users need to be able to authenticate themselves, as well as define, edit and save their personal user profile for receiving personalised services. Then, front-end users need to search into internal and external knowledge repositories, through local and remote search agents, and retrieve learning material according to their specific requirements and preferences. Based on the results of these (personalised) searches, front-end users need to be able to build, edit, update and save personal knowledge routes – collections of learning resources which are appropriate for their needs. Finally, front-end users need to “interact” with these knowledge routes for improving their knowledge, and have their profile updated accordingly. Front-end users require these actions to be contextualised, that is, based on their changing requirements within different e-learning and e-working settings.

Back-end users

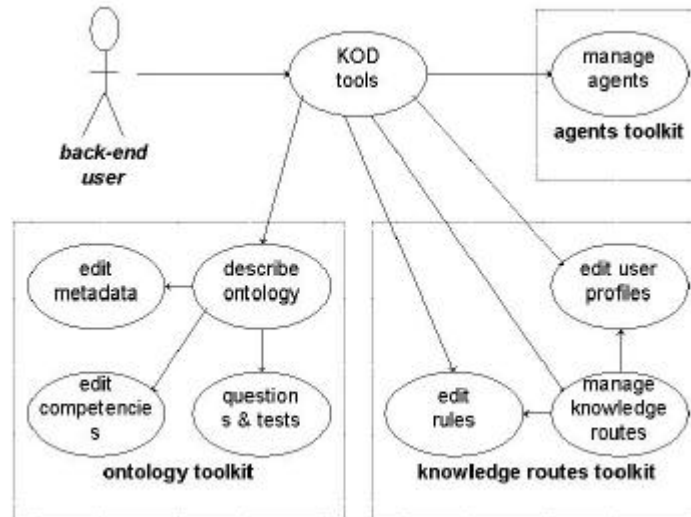


Figure 3. Typical tasks for back-end users

Back-end users need to be able to publish their learning material in a commonly accessible format, so that it can be effectively and efficiently searched and retrieved in the different contexts of use described in section 0. This, in turn, requires that back-end users can describe the meta-data of each resource, as well as the competencies, questions & tests, etc, that are related to each resource. Moreover, this description should be according to a common ontology, to promote semantic interoperability of resources. Also, back-end users need to be able to describe collections of resources (as opposed to “atomic” resources), as well as how these collections are disaggregated, so that different knowledge routes (parts of the learning packages) are presented according to different user profiles, thus meeting the requirements for on-demand, personalised learning. This involves the definition and editing of the respective user profiles through a knowledge routes toolkit. Finally, back-end users need to be able to “configure” their applications and services, so that they can meet diverse requirements. This involves a set of “agents”, which can act as a communication, integration and customisation mechanism.

Towards a Technical Solution

It can be argued that the current state-of-the-art does not adequately support the requirements identified in the previous sections, and especially for:

- common description of learning material: existing specifications, such as the IMS Content Packaging Specification (IMS, 2001), facilitate the description of “content packages” (“collections” of learning units) in a common format; however, the current version of these specifications enables only the definition of table of contents-like, static structures; therefore, when an e-learning system imports a content package, it can only present the same material to all users (IMS 2001), thus the requirements of front-end users for on-demand, personalised learning cannot be met with the current specifications.
- architectures for e-learning applications and services: as a result, existing architectures and systems cannot support the requirements of the different categories of back-end users for increased interoperability and re-usability of learning material, applications and services. Most efforts towards the provision of on-demand

learning result in intelligent tutoring systems which cannot be easily re-used across different domains (Brusilovsky et al., 2001; Sampson et al., 2002).

In this context, we are currently working on a technical solution which can overcome some of the above limitations, and can meet the requirements for on-demand learning. We are working on the knowledge packaging format, an extension of the current version of the IMS Content Packaging specification, to enable the definition of adaptive educational content (see Figure 4).

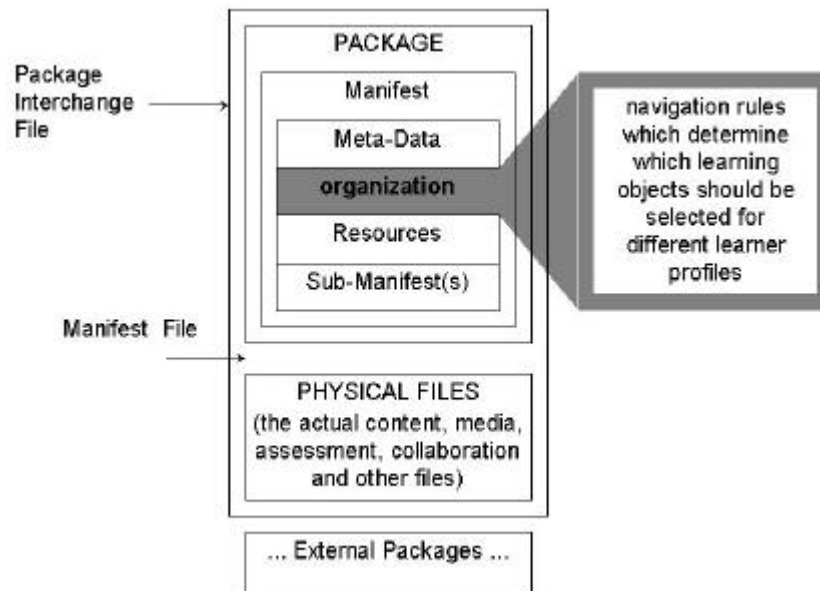


Figure 4. The Knowledge Packaging format
(Grey areas denote the extensions over the IMS Content Packaging Specification)

The knowledge packaging format facilitates the description, in a common format, of the learning objects comprising each learning package, together with navigational rules which define which parts of the learning package should be selected for different learner profiles. As a result, an e-learning system can import knowledge packages (i.e. collections of learning objects described through the knowledge packaging format), interpret the rules included in them, and present different knowledge routes to each learner, according to his/her profile, thus facilitating personalised learning. Moreover, adaptive knowledge packages (i.e. adaptive learning material) can be easily interchanged and re-used across different e-learning applications and services, thus promoting on-demand, personalised learning (see Karagiannidis et al., 2001a, 2001b).

Based on the knowledge packaging format, we have developed an architecture which enables back-end users to produce adaptive learning material which can be easily exchanged and re-used. In particular, we are developing:

- a set of authoring tools for content authors, which are based on the knowledge packaging format described above, and facilitate the creation and publishing of adaptive content; since this adaptive content is described in a common format, it can be easily interchanged and re-used across different e-learning applications and services;
- a set of re-usable building blocks for e-learning platform providers, which can be integrated in existing e-learning, e-publishing and e-knowledge platforms, so that they can import adaptive content that is described according to the knowledge packaging format, and present different parts to each user, according to his/her profile; and
- a set of tools for e-learning service providers, which are also based on the knowledge packaging format, and enable them to integrate their own or third party learning material and/or e-learning applications and services, and provide advanced, on-demand brokerage services (for more information, see Cardinali & Sampson, 2001).

The above developments are planned to be demonstrated into two different scenarios, to assess the impact of our work into different learning and working settings. Both scenarios involve the development of adaptive learning material (in the tele-medicine and knowledge management domains, respectively) by back-end users through the above mentioned tools. In the first scenario, a group of life-long learners will have personalised access to tele-

medicine adaptive learning material within an elearning setting. While, in the second scenario, knowledge workers of a high-technology company will have personalised access to knowledge management adaptive learning material within an e-working setting, i.e. during their every day working activities, to improve their performance in their everyday tasks, and their competency in the knowledge-based economy.

Acknowledgements

Part of the work reported in this paper is carried out in the context of the KOD “Knowledge on Demand” Project (www.kodweb.org, kod.iti.gr), which is partially funded by the European Commission through the Information Society Technologies Programme, under Contract No IST-1999-12503.

References

Brusilovsky, P., Karagiannidis, C., & Sampson, D. (2001). *A Case for layered evaluation for adaptive applications and services*. Unpublished manuscript.

Cardinali, F., & Sampson, D. (2001). The KOD knowledge-on-demand packaging toolkit: Sharable adaptive content objects packaging, re-usability and brokerage for learning society. In *Proceedings of the European Multimedia, Embedded Systems and Electronic Commerce Conference (EMMSEC 001)*, Venice, Italy, October 17-19, 2001.

European Commission (2000). *A Memorandum on Lifelong Learning* [online] . Available: <http://europa.eu.int/comm/education/life>.

Hartley, D. E. (2000). *On-demand learning: Training in the new millennium*. Amherst, MA: HRD Press.

IMS Global Learning Consortium, Inc (2001). *Content packaging specification* [online]. Available: <http://www.imsproject.org/content/packaging>.

Karagiannidis, C., Sampson, D., & Cardinali, F. (2001a). An architecture for defining adaptive educational content. In *Proceedings of the IEEE International Conference on Advanced Learning Technologies (ICALT 01)*, Madison, USA, August 6-8, 2001.

Karagiannidis, C., Sampson, D., & Cardinali, F. (2001b). Integrating adaptive educational content into different courses and curricula. *Educational Technology & Society*, 4(3), July 2001.

Sampson, D. (2001). *Current and Future Research and Technology Developments in e-Learning*. 2nd International Conference on New Horizons in Industry and Education, Milos Island, Greece, 13-14 September 2001.

Sampson, D., Karagiannidis, C., & Kinshuk (2002). Personalised Learning: Educational, Technological and Standardisation Perspective. *Interactive Educational Multimedia*, Special Issue on Adaptive Educational Multimedia.

Senge P. M. (1990). *The 5th Discipline: The Art and Practice of the Learning Organisation*. New York: Doubleday/Currency.