

Flexible Learning Systems: An Insight into Personalised Learning Systems

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Abstract. Web services are defined as accessible software programs exposed through an Internet interface description which enhances client to server requests and are not only easily invoked and consumed but they provide interoperability for applications through Service-Oriented Architectures. The Semantic Web, Web services and Web technologies, have so far been mostly utilised in business models and processes throughout industry. This research paper proposes to show how these emergent technologies are also being exploited for E-learning environments. Such a service applies in fact not only to businesses and the work-place but also to academic settings. The ability to make a provision for flexible, personalised and adaptable services is heavily dependent on Web technologies which need to be moulded into rich, dynamic and active environments based on individual user needs and requirements. The paper aims to highlight ongoing projects in this area offering a brief description of their findings and achievements as well as identify future trends in the areas of flexible learning systems.

1 Introduction

E-learning has developed and evolved over the years from learning management systems, dealing with course management, design and delivery through systems which involve the learners in a more active rather than a passive way. Hart, [Har07] mentions how the approach to e-learning is now being moulded according to a methodology which stimulates collaboration and sharing in peer to peer environment. This is at the core of the socio-constructivist approach as is the knowledge sharing in an environment which stimulates harvesting and retrieving information for the sole purpose of learning, in what is also termed as an informal learning process. This new evolution of the virtual learning settings renders the online environment more *learner-centred* which as Downes [Dow05] refers to “is the placing of the control of learning itself into the hands of the learner”. This new evolution stems from the new vision of the web, the semantic Web or Web 2.0 “in which information is broken up into *microcontent* units that can be distributed over dozens of domains. The Web of documents has morphed into a Web of data... now we’re looking to a new set of tools to aggregate and remix microcontent in new and useful ways” [MP05]. Commercially this transition is seen in sites which have migrated from simply displaying static content to

deploying services in the Web context, which provide interfaces to content which is shareable. Such a provision of information as applied to the e-learning context makes the whole learning experience more dynamic and flexible around the user's educational needs. Downes refers to this approach to learning as being different with the content which becomes distributed in more heterogeneous format in a manner which syndicates information such as a blog post or podcast to be collated and accumulated by the learners. This idea renders a wider perspective to the terms ubiquitous computing as applied to e-learning, where the concept of education which is context free, platform free, independent of time and location, makes learning and living merge together. "The challenge will not be in how to learn, but in how to use learning to create something more, to communicate" [Dow05].

This paper is structured as follows; a brief description of flexible learning systems which also includes an overview of personalisation and the effect of the Semantic Web and Web Services to facilitate such online flexible systems, is given at the beginning. The paper then looks at emerging trends in the approach towards more dynamicity within online learning systems and the key developments in the personalisation and adaptability of systems which a number of projects are currently undertaking to conclude with some possible direction to future projects in the area of personalisation in online learning.

2 Flexible Learning Systems

In order to make learning systems more flexible and adapted to the learner needs and requirements, Dagger et al [DOL⁺07] have looked at service-oriented architectures and how to go about making use of them for Web Service choreography. The first emergent need for such platforms with a 'service-vision' stems from the number of increasing issues related to interoperability of structures as well as the efficiency and effectiveness of the orchestration and choreography of the various services. As MacManus and Porter [MP05], indicate in their article, the effects of the Web 2.0, the read-write web which is being brought to life by the new generation of demanding users, and upon which the new e-learning is being moulded, bring about a transition towards XML or Semantic markup, as well as the provision for Web Services, making users move away from the local static environment towards a domain based on the dynamic discovery and assembly of services in the learning context defined by the user according to his personal needs and requirements. Flexibility thus becomes defined in terms of the interoperability of services in the e-learning environment.

2.1 Static E-Learning vs. Dynamic Services

The evolution of a new generation of e-learning standards and platforms refers to a modification and a shift in the provision of services from the simple course management systems which are currently trying to advance more in the area of

content sharing and reusability but which however are still not entirely “learner-centric” [DOL⁺07] towards systems which are more adaptable to the learners’ needs. Dynamic e-learning services in addition according to the authors, not only “include traditional functionalities such as authentication, tracking, course management, scheduling, activities, tools, and assessment” but also “emerging functionalities such as personalisation, resource harvesting, context management, federated exchange, simulation, games, wiki, blogging, podcasting, and so on”. In order to come up with these functionalities a number of ongoing projects are currently working towards creating standards, frameworks and technologies upon which such service based activities can be built in order to provide the interaction necessary from different platforms using different environments.

2.2 Semantic Web Services for Education

The composition of Web Services, which can be very simply described as software components designed to be accessible by a number of applications, enhances their value in carrying out complex and multifunctional tasks which the user requires specifically [SWGS05]. Their primary benefit lies in the interoperability standards they operate under such as the use of XML-based messaging [Cav06]. Web services work in close conjunction with and are heavily dependent on Semantic markup, which provides for a machine-processable language which can be universally understood across platforms and environment. The advent of XML technologies, have in fact rendered static content displayed upon pages more dynamic, able to be shared amongst the different users using choreography for a workflow based process [MP05]. This integration of Semantic markup for the purpose of Web Services enhances their discovery and augment their inter- and intra-domain operability which lies at the basis of workflow processes. Such an integration would not be possible without “domain ontologies” which need to broadly hold the content of the e-learning sphere. Semantic Web, Web Services, and Ontologies together with the functionalities needed for collaboration, on-the-fly request processing, as well as business processes design and modification create the need for a workflow which binds all these aspects together. A whitepaper by the Workflow Learning Institute defines this workflow process as “the real-time result of collaboration between people and systems (the workforce) in the WorkSpace” [Adk03]. This would in addition mean that Web services would be modified to embed e-learning functionalities, such as personalisation through the use of service-oriented architectures, in a way that e-learning structures become events triggered by other applications.

2.3 Personalisation and Adaptivity for Learners

The need for more learner-centric adaptations in the field of e-learning stems from the evolution of new technologies which allow for the flexibility and dynamicity in such a way that the learners can choose their own course of learning in the manner which is most suitable to their needs [Att07]. These are the

thoughts generated within the report for Learning Light, regarding the generation of demand for e-learning. According to the authors of the report “the increasing pervasiveness of ICT in the workplace and home provides a platform for a wide range of learning opportunities that many organisations will be able to exploit to enhance the flexibility and motivation of their workforce, and to encourage lifelong learning generally. Searching the Internet for ‘just-in-time’ information to meet a particular need has become an everyday habit for many — with the scope to extend this to further informal and formal discovery and learning” [JKS05]. Although the report takes the idea of e-learning from the workplace for employees, this same concept can be applied to university level students who wish to build and expand on the theories within classes to supplement their own research demands which at times vary from the static and often highly specific content delivered in the classroom. Thus the ability of the learners to gain control over their own learning process lies at the basis of personalisation in learning. This makes them more participative and active within their own learning process stimulating motivation.

3 Emergent Trends in Personalisation and Adaptation for Learners

Personalisation making use of new Web technologies has given rise to a number of projects and working groups whose aim is to establish standards and frameworks needed for the integration and choreography of the Web Services in order to “modularise functionality” [DOL⁺07]. Such is the scope of the IMS Abstract Framework¹, as well as the E-Learning Framework² which identify core components of e-learning and the e-learning systems common functionalities respectively. The Open Knowledge Initiative³ on the other hand defines service layers for e-learning, promoting specifications which describe how software components communicate with each other and with other applications in the online environment. Various projects are in addition pioneers in the creation of a range of sustainable “e-learning services” based upon collaboration and sharing of expertise through the use of Web technologies.

3.1 Simple Knowledge Organisation Systems

SKOS, Simple Knowledge Organisation Systems⁴ which falls under the W3C’s Semantic Web Interest Group, also informally known as ‘Something Kool, Original and Sexy’ refers to a framework which is simple yet powerful enough for expressing knowledge structures in a machine-processable manner for use on the Semantic Web. This framework is moulded around an RDF Schema for thesauri,

¹ IMS <http://www.imsglobal.org/ep/>

² ELF <http://www.elframework.org/>

³ OKI <http://www.okiproject.org/>

⁴ SKOS <http://idealliance.org/proceedings/xtech05/papers/03-04-01/> & <http://www.w3.org/2004/02/skos/references>

classification schemes and taxonomies amongst others [MMWB05]. The concept of using Resource Description Framework (RDF) is that of providing interoperability between data sources which can be “distributed in a decentralised way, but still be meaningfully composed and integrated by applications, possibly in novel and unanticipated ways”.

3.2 iClass

iClass⁵ stands for Intelligent distributed Cognitive-based open Learning Systems for Schools. Its main aim is that of providing an environment which is adaptable to learners’ needs, as in personalised learning systems. It aims to design, develop and implement a framework which is based on a classroom based pedagogical model emphasising self-regulated learning. The system collects and processes data from the users in such a way that it is presented back to them in manner which supports a meaningful path of their learning process. iClass makes use of services which serve to model the learner behaviour through profiling and monitoring.

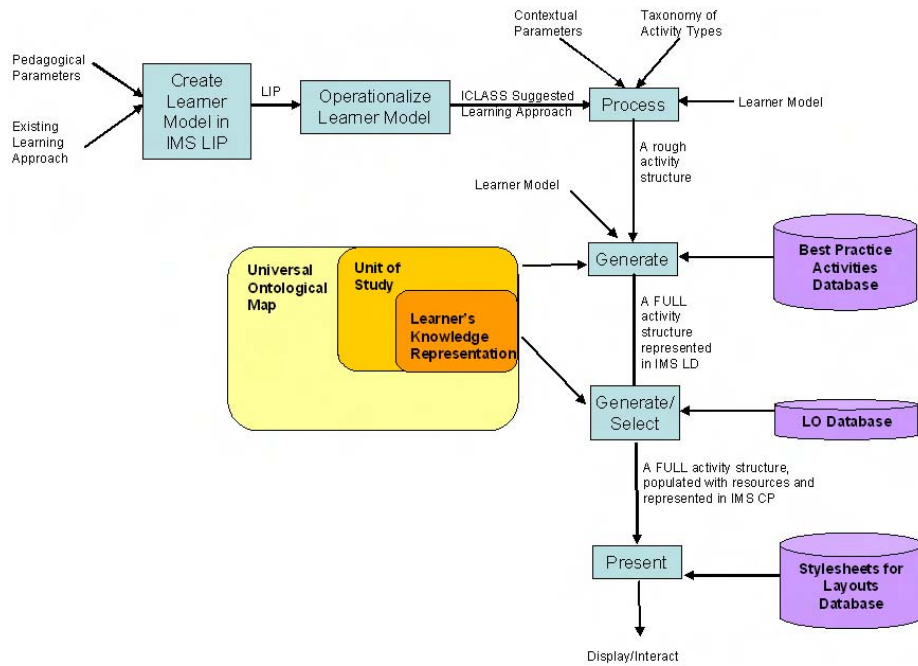


Fig. 1: The I-Class Content Flow Model [TGC05]

⁵ iClass <http://www.iclass.info/iclass01.asp>

3.3 PROLearn

PROLearn⁶ is a ‘Network of Excellence’ which deals with ‘technology enhanced professional learning’. Thus it deals with aspects of providing insights into the world of lifelong learning when it comes to the working experience for the benefit of employees who wish to keep up with the knowledge their profession requires. PROLearn which is an FP6 funded project which is based on a number of research activities and deliverables in the area of professional learning within the ‘workplace setting’. One of its research areas focuses on personalisation in learning.

Adaptive Personalised Learning Service APeLs APeL⁷ is an initiative to adapt and integrate a variety of perspectives on personalised learning. The project in itself delivers standards as well solutions for personalised learning systems through the interoperability of learning components in order to provide a flexible and adaptable learning experience.

3.4 Unfold

This project which ran up until 2005 aimed to provide an implementation for the IMS Learning Design and framework for the purpose of solving interoperability issues. The UnFold⁸ project aims at education in the industry sector using the learning designs and standards already in place by the IMS. This project has also maintained a close working contact with PROLearn through the setting up of specialised communities of practice (CoPs) in order to share expertise and collaborate on learning design for teachers and designers themselves as well as systems development.

The concept behind the whole project was that of supporting the IMS Learning Design whose aims and objectives were to enable “flexible and sophisticated pedagogical approaches to eLearning, by providing support for:

- multiple as well as single learners and their coordination
- a wide range of present, as well as future, pedagogical models
- learning activities and learning services, as well as content” [Gri05].

Therefore the Unfold project was created to provide the support for this learning design, “conceived of as a measure to promote and coordinate the adoption, implementation and use of IMS Learning Design and related specifications”.

⁶ PROLearn <http://www.prolearn-project.org/index.html>

⁷ APeLs <http://www.prolearn-project.org/articles/wp1/index.html>

⁸ Unfold <http://www.unfold-project.net:8085/UNFOLD>

3.5 L4All

The L4All⁹ project is a web-service based system for lifelong learners aiming to provide support for lifelong learners, providing easy access to information, planning for future learning, as well collaboration and sharing expertise amongst peers. The methodology which this project follows is that of eliciting User and Technical requirements for technology standards and existing services. The concept is that post-16 learners, are able to trace out their own personal learning pathways, thus creating a motivational route for these same learners to progress to higher education. This project which is also funded by the JISC Distributed e-learning programme, aims to offer

“(i) interaction with a Web Portal that provides information on work-based, FE and HE courses and modules available to learners in the London region; (ii) personalised support in planning and reflecting on personal development and lifelong learning activities; (iii) advice on learning and personal development; (iv) support in designing and maintaining personal learning and development plans; (v) support for learners to share information and collaborate with peers and tutors” [FMO⁺06]. L4ALL thus enhances and stimulates motivation in learners for participating in lifelong education.

3.6 Tangram Project

The Tangram Project¹⁰ is better defined as being an Integrated Learning Environment for the Semantic Web. It makes use of Semantic Web technologies and Ontologies in order to build new content from existing content units to dynamically assemble learning content. Based on the number and the structure of the ontologies it makes use of, Tangram provides Learning Objects for Content Authors with little manual operations, whilst it also provides personalised learning content adapted to the students’ level of knowledge, learning style and personal preferences as well as quick access to a topic of interest. The project delivers a web application which not only makes it easier for content authors to provide their content but it also provides the necessary framework for rendering semantic annotation easier, which is then used to help the learners achieve more control over their own learning objects and individual knowledge units.

3.7 Adaptive Hypermedia Architecture (AHA!)

The AHA!¹¹ project started out in order to provide support to an online course, however the modifications which it underwent through have shaped it into an adaptive structure, built on user models based on concepts and specific user attributes. Adaptivity is reached through the utilisation of content level and link level adaptation for the same content based on user profiling. The concept

⁹ L4ALL <http://www.lkl.ac.uk/research/l4all/>

¹⁰ Tangram <http://iis.fon.bg.ac.yu/tangram/>

¹¹ AHA! <http://wwwis.win.tue.nl/~{}debra/ht03/pp401-debra.pdf>

behind this project is that of providing users with a domain and adaptation model based on the user model using Java Servlet technologies and Applets. One of the future aims for improvements to this project lies in the development of a system which is capable of invoking other adaptive applications and cross-communicate with them.

4 Conclusion

This paper has looked at trends, ideas and concepts behind the application of systems which enhance personalisation in the online learning environment. The concern for an evolution in the virtual learning environment has stemmed from research branching out from the field of e-learning and pedagogical issues affecting learners. Learners are changing, their needs are changing and so are the technologies. Having statically presented content within a management system or virtual platform, which is more administrative rather than pedagogical is rapidly becoming extinguishable. A merge between the technologies such as Semantics, XML, and learning thus becomes a necessity for the benefit of the learners making use of the Web as a platform for their knowledge development. A number of projects are promoting lifelong learning for the work-setting and for professionals. Future developments seem to indicate an area which is still yet unexplored. The choreography and orchestration of Web Services across Universities and other higher education institutions reaching over different geographical locations and continents can be utilised to discover and invoke other services and applications which can in turn enable learners to trace their own path to learning, participating actively in furthering their knowledge levels in academic research. Semantic mark-ups, technologies such AJAX, the use of Ontologies, and Web Services are all indicative of the way forward across which the new Web is evolving. Extending this way forward to learning accessible for all, irrespective of place, location, usable technologies, and learning styles seems one of the logical steps in the evolution of e-learning.

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