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de Freitas, S., Magoulas, G., Oliver, M., Papamarkos, G., Poulouvassilis, A., Harrison, I. and Mee, A. (2006) L4all-a web-service based system for lifelong learners. In: Proceedings of eChallenges'2006 (Workshop on Next Generation in Technology Enhanced Learning), 25-27 October, Barcelona, Spain, pp. 1477-1484.

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L4All – a web-service based system for Lifelong Learners

Sara DE FREITAS¹, George MAGOULAS¹, Martin OLIVER², George PAPAMARKOS¹,
Alexandra POULOVASSILIS¹, Ian HARRISON¹, Adrian MEE²

¹*London Knowledge Lab, Birkbeck, Emerald St, London WC1N 3QS, U.K.,*

Email: {sara, gmagoulas, g.papamrkos, ap, ian}@dcs.bbk.ac.uk

²*London Knowledge Lab, Institute of Education, Emerald St, London WC1N 3QS, U.K.,*

Email: {m.oliver, a.mee}@ioe.ac.uk

Abstract: L4All is a pilot system that records and shares learning pathways through educational offerings with the aim of facilitating progression of lifelong learners from Secondary Education, through to Further Education and on to Higher Education (HE). The focus is on helping those post-16 learners who have traditionally not participated in HE. The L4All system allows learners to access information and resources registered with the system by their providers, to plan their own learning pathways, and to maintain and reflect on their learning throughout life. Tutors are able to register recommended pathways through courses and modules (which might be developed by a number of providers) thereby encouraging progression into HE. The system allows learners to share their learning plans and pathways with other learners (if they wish) in order to encourage collaborative learning and collaborative formulation of future learning goals and aspirations.

1. Introduction

The **LifeLong Learning in London for All – L4All** project (see <http://www.lkl.ac.uk/research/l4all.html>) is funded under the JISC Distributed e-Learning Programme (http://www.jisc.ac.uk/programme_edistributed.html) and has focussed on supporting the independent lifelong learner, particularly those 16+ learners who traditionally have not participated in higher education. We believe, on the basis of research into life course choices, that there are two closely related issues that contribute to this non-participation: firstly, a lack of information about education opportunities, and secondly a perception that such options are ‘not for me’, leading to self-exclusion from such opportunities. The situation appears to be particularly acute for those who identify themselves as being from ethnic minorities or as having an impairment that may affect their participation.

L4All aims to provide lifelong learners in the London region with access to information and resources that facilitates their progression from Secondary Education, through to Further Education (FE) and on into Higher Education (HE). To achieve its aims, the L4All project has brought together a diverse group of people from different disciplines and a range of institutions all of whom are committed to providing learning opportunities which enhance career development and widen participation across the London region.

The L4All project has been informed by other recent projects undertaken by researchers from Birkbeck and the Institute of Education at the London Knowledge Lab, including the EU SeLeNe project (Keenoy *et al.* 2005) and the EU Kaleidoscope project (Keenoy *et al.* 2004a, 2004b) as well as research reported in (Papanikolaou *et al.* 2003, Peterson and Levene, 2003, Magoulas *et al.* 2005). L4All allows tutors and learners to create learning pathways through the learning resources registered with the portal by their

providers. As an aid to constructing their own learning pathways, learners are able to search for pathways provided by tutors and other learners. This gives learners a repertoire of learning possibilities that they may not have otherwise considered, allowing sharing of successful learning pathways and presenting successful learners as role models to inspire confidence and a sense of opportunity amongst those previously excluded.

The following sections of the paper address the aims and objectives of the *L4All* project, methodology, development approach and technologies used, results, outcomes and finally conclusions and directions of future work.

2. Aims and Objectives

The *L4All* project has as its aim the development of a pilot system that provides an environment for the lifelong learner to access quality-assured learning materials, personal development plans, recommendation of learning pathways, personalised support for planning of learning, and reflecting on learning. The system 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. The following objectives were identified at the outset of the project in order to achieve these aims:

- Definition of *User Requirements*, *Usage Scenarios* and *Technical Requirements*.
- *Metadata Generation and Provision*.
- *Development of the Pilot*.
- Employment of a user-centred *Evaluation Process* that uses usability inspection methods, including user testing and heuristic evaluation, to improve the system so that the needs of learners and providers can be met.

3. Methodology

The *L4All* project was structured around a number of work packages. First, the User and Technical Requirements were produced, in early 2005. For the former, we first considered previous models of learner choices in career and education. These previous models were rational and economic choice based and therefore a poor match with the target learner community. We therefore proposed an alternative model based upon *trails* (Bush, 1945; Peterson and Levene, 2003) of learning resources and opportunities, which we believed could provide a more holistic approach to learners' experience of life and continuity between their learning episodes and work experiences. We conducted a series of user studies which aimed to define the users' needs and requirements of the system, including the main functionality required, how this functionality should be provided to the user, information to be solicited from users, the information to be returned by the system, and the interaction between different components of the system.

Usage scenarios for the *L4All* system were formulated by consultations with relevant stakeholders, including widening participation officers of the institutions and colleges of the consortium, groups of learners, tutors, student liaison committee members, and content providers. Among the main aims of this consultation process was to identify learners' individual educational goals and objectives, articulate expectations for the learner's performance in general education activities, and accommodate different user needs and individual differences. The outputs of these sessions provided the basis of the user requirements and specification of the system.

The initial technical requirements mandated by the JISC Distributed e-Learning programme were that the *L4All* functionality would be provided, as much as possible, by existing e-tools and services compliant with the JISC E-Learning Framework and service-oriented architecture (http://www.jisc.ac.uk/index.cfm?name=elearning_framework). The *L4All* Technical Requirements were elicited by: (i) undertaking a study of candidate portal technologies and a critical evaluation of them that identified *uPortal* (www.uportal.org) as the most appropriate choice; (ii) undertaking a study of existing e-tools and services provided by other JISC-funded projects that could provide relevant functionality to *L4All*; (iii) specifying a system architecture that used a selection of these tools as well as *uPortal*, Apache Tomcat and Apache AXIS SOAP; (iv) undertaking a study of e-learning metadata standards relevant to the *L4All* application domain that identified *IMS Metadata* (<http://www.imsglobal.org/metadata/>), *IMS-LIP* (<http://www.imsglobal.org/profiles/>) and *eduPerson* (<http://www.educause.edu/eduperson/>) as the most appropriate standards to be used as the basis for describing the *L4All* learning resources (IMS Metadata) and the *L4All* users (IMS-LIP and *eduPerson*); and (v) identifying RDF and the Jena framework (<http://jena.sourceforge.org>) as providing a flexible, portable solution for storing the *L4All* metadata.

After the specification of the User and Technical requirements, there followed the Development of the Pilot, and the Metadata Provision and Generation phases. A number of extensions to the standard metadata schemas were first designed in order to fully support the *L4All* functionality, namely metadata describing learning pathways and additional metadata for the login details, contact details and learning preferences of users.

The pilot system was developed in two phases, resulting in two versions during the lifetime of the project. This was in order to allow an early first phase of evaluation that would allow the user requirements and usage scenarios to be validated by a range of user stakeholders. This would demonstrate the benefits of a large subset of the envisaged functionality of the pilot, detect non-compliant situations and identify possibilities for improvement. The outcomes of this first evaluation phase served as input into the development of the second, functionally complete, version of the pilot. The outcomes of the second evaluation phase, which has just been completed, will be used to make any further necessary improvements before the public release of the third version later in 2006.

The first version was produced in July 2005 and incorporated the user requirements identified earlier relating to search over courses (provided by the DELTA service <http://www.essex.ac.uk/chimera/delta/index.html>), learning pathway creation and management, searching on pathways, and user profile creation and management. Further improvements were made to this first version in parallel with the first evaluation phase during July – September 2005, relating mainly to pathway management. The second version of the pilot incorporated also a visual front-end and an automatic course sequencing service (using the ISIS sequencing engine <http://www.hull.ac.uk/esig/isis.html>) and was completed in February 2006.

The Metadata Provision and Generation work package took as input the *L4All* metadata specification produced earlier. Staff with responsibility for managing the information required for the *L4All* metadata fields were identified within the participating institutions, and they provided the necessary metadata for loading into the pilot's metadata repository via a simple loading tool.

The Evaluation work package was organised in two phases. The first phase focused upon the first version of the pilot and aimed to fine-tune the user requirements and usage scenarios through consultation with student representatives, tutors, widening participation officers and content providers by examining how different users interact with the system. Given this purpose, conventional Human-Computer Interaction methods were adopted for this phase. The outputs of the first phase helped to identify improvements and initiate

actions in order to implement these improvements. The second evaluation phase was on the second version of the pilot. This phase adopted heuristic evaluation methods focusing upon usability issues, as defined by Nielsen (2006) and Nielsen and Loranger (2006). To ensure that the final system was robust enough to cope with real-world use, it was imperative that users evaluate the pilot to assess its function and performance, and determine if the user requirements have been fully met. This second evaluation round has taken the form of remote usage of the system in conjunction with an online survey, face-to-face interviews with learners, and discussions held using the Blackboard virtual learning environment. The evaluation has centred upon three main user groups: learners, prospective learners and careers advisors. The evaluation activities were designed to inform both design parameters (are these the right tools to develop?) and usability issues and concerns, including accessibility (can learners use these tools?). The feedback from is second phase is now being used as the basis for undertaking any further necessary improvements to the pilot before releasing the final version later in 2006.

4. Development Approach and Technologies

The L4All pilot consists of a set of components and services. The architecture comprises two parts: (a) the backend and (b) the user interface. The user interface comprises two parts. A Web portal that serves as a platform for the user interaction components to be built upon, and a Flash application that interacts with the backend and presents to the user the L4All functionality relating to the creation of personal timelines, searching the available courses metadata, searching for other users and other timelines, and obtaining recommendations regarding future learning. The backend connects with the underlying RDF repositories for storing, retrieving and modifying metadata describing users, courses and timelines. It also integrates three external services: DELTA, ISIS and a service for search and retrieving information about courses in the LearnDirect database (<http://www.learnirect.co.uk/>).

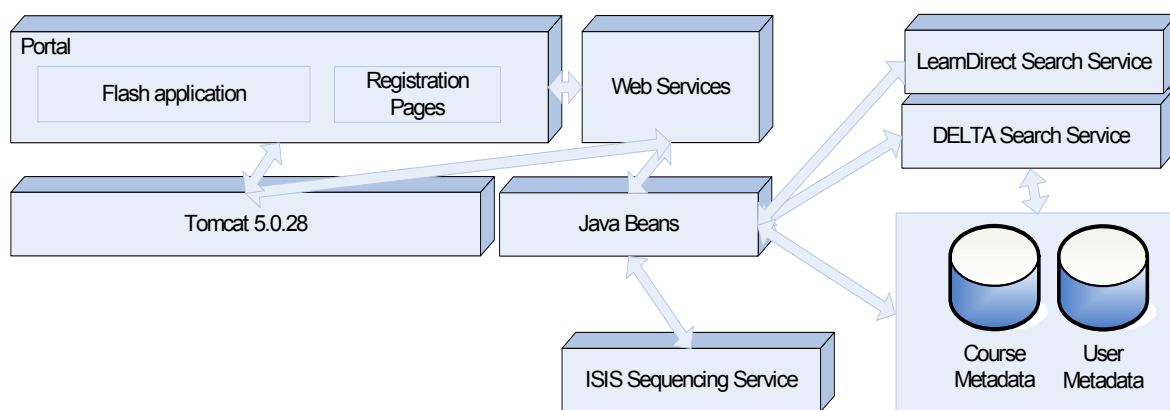


Figure 1 L4All pilot version 2 components

Figure 1 illustrates the overall architecture and its major components. The Web Services component consists of a set of web services which we have developed in order to wrap the backend functionality into a set of services that can be called by the user interface. These web services are implemented as Java servlets over Apache Tomcat. They accept GET and POST requests from the user interface components and dispatch them to the appropriate Java Bean for processing. The results of processing are passed from the Java Beans back to the called service where they are formatted into XML and passed back to the calling user interface component. The Java Beans are a set of Java classes providing the core backend functionality. This is where the three external services are integrated with the system and where communication with the metadata repositories is handled, including all actions relating to storing, retrieving and modifying the course and user metadata.

5. Results

The L4All pilot has achieved almost all of the user requirements identified in the early part of the project, successfully integrating a set of external services, tools and resources exhibiting high heterogeneity. The user interface provides screens for: user registration and login; a home page providing links to the main L4All functionality; a screen for entering personal details relating to past and present occupation, skills, qualifications, interests, future learning goals and preferred study type (full-time or part-time); screens for creating personal timelines incorporating past and future episodes of learning and work; and screens for searching over courses, timelines and other users based on a variety of search criteria.

Figure 1 shows the main screen for timeline creation. In the top left-hand box there appears a brief description of the user's details and preferences. To the right of this, the My Courses box is where the results from searching the courses information are listed while the My Recommendations box is where the system-generated recommendations are listed. Below that, a set of icons provides a rich set of predefined episodes that can be chosen to be placed within the user's timeline. The user can choose from this set of episodes or can create a new custom episode by selecting the NEW link at the bottom of icons box.

At the very bottom of the screen, the user timeline is represented as a stripe with the years annotated on the top of it. The user can choose to create a new episode for the timeline from the range of icons or from the results from a courses search (see below). The new episode can be placed on the timeline by simply dragging and dropping it onto the timeline. When dropping onto the timeline, a new dialog box pops up (see Figure 2) for the user to specify the details of the new episode. Saving the new episode in the timeline initiates (transparently to the user) a synchronisation of the visual front-end with the databases at the backend.



Figure 1. User interface for timeline creation.

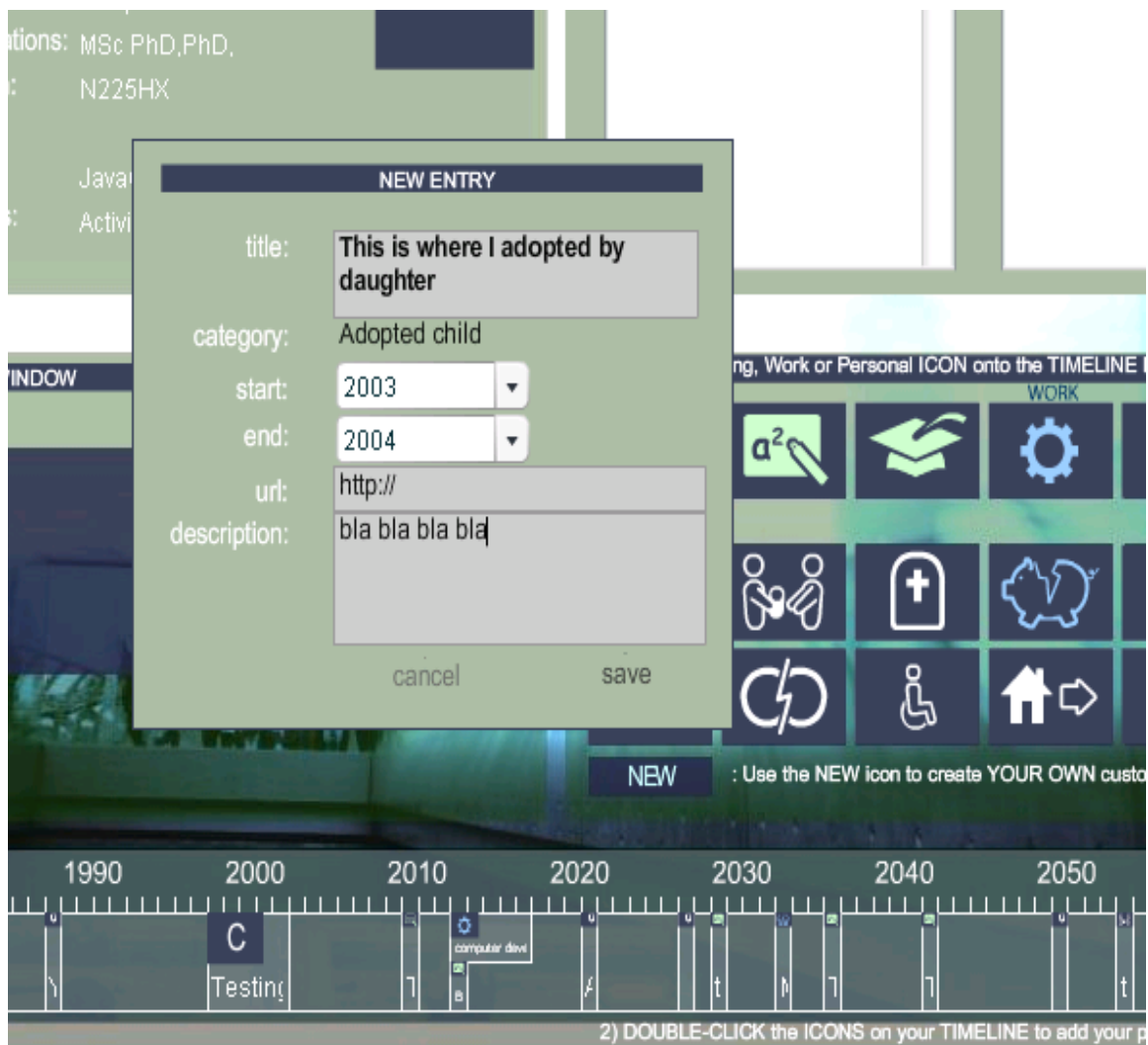


Figure 2. Add new episode.

The user can search for courses by clicking on the SEARCH COURSES link in Figure 1. A search dialog pops up that allows the user to specify the search parameters, ranging from a general keyword, to the distance the user is willing to travel in order to attend a course, the postcode of the course, the level of the course, the institution providing it, the subject covered and the type of the course (full-time or part-time). The search mode can be chosen so as to set matching to all of the specified criteria (AND) or any of the specified criteria (OR). The search results appear in the My Courses box, from where they can be dragged and dropped on the timeline.

Clicking on SEARCH TIMELINES in Figure 1 opens a new window for searching for timelines by providing a keyword or the title of an episode within a timeline. The results are presented in a list from which a timeline can be selected to be viewed in more detail. Clicking on SEARCH USERS in Figure 1 again opens a window for search for users via a set of search criteria including skills, qualifications, interests, age and occupation.

The second evaluation phase (of version 2 of the pilot) centred upon usage of the functionality provided by the system with three user groups: Further Education learners from the Community College Hackney; mature learners on Birkbeck's IT Applications Certificate/Diploma programme; and mature learners on the Institute of Education's postgraduate teacher training programme. Users were invited to complete a range of tasks using the system, and after completing these tasks to reflect upon these activities as part of

an online survey structured around (i) aesthetics, navigation and general user experience, (ii) timeline creation, (iii) search and expectations, and (iv) quality of user support.

The main preliminary finding of the second evaluation phase has been the overall endorsement of the *L4All* pilot. There was agreement across all user groups of the potential of the approach to support otherwise excluded learners. Particularly positive was the response of Further Education learners suggesting that this might be an appropriate group on which to focus further development work. The evaluation study has also been useful in identifying areas of further technical refinement and development that are required in the coming months e.g. differentiating the needs of different learner groups and developing strategies for differentiated interaction with the system; extension with e-portfolio and online journal capabilities; and extension with a 'live chat' facility. Another interesting observation was the way in which visualisation of learning and work choices prompted users to rethink their own identity as a learner and potential employee.

6. Outcomes

The *L4All* project has achieved its stated aims and objectives. The main project outcome has been the development of the *L4All* pilot system. A Web Portal has been developed that allows learners to access information and resources registered with the portal by their providers, to plan their own learning pathways, and to maintain and reflect on their individual record their learning throughout life. Tutors are able to publish recommended pathways through courses and modules in the London region. The *L4All* system allows learners to share their learning plans and pathways with other learners (if they wish) in order to encourage collaborative learning and collaborative formulation of future learning goals and aspirations.

The methodology we have adopted in developing the *L4All* pilot has enabled a significant input into the development of the system from major stakeholders throughout the lifetime of the project (learners, instructors, institutional representatives and others). Hosting the *L4All* project at the London Knowledge Lab has allowed this approach to be readily employed due to the broad base of multi-disciplinary in-house expertise and the Lab's extensive links (either directly or via its parent Birkbeck College and Institute of Education institutions) with schools, FE colleges, and other FE/HE stakeholders.

The London Knowledge Lab is committed to sustaining and supporting the *L4All* system through our involvement with the recently announced Birkbeck-led Lifelong Learning Network (LLN) comprising several London FE and HE institutions. It is planned that the *L4All* pilot will be rolled out to support the early activities of the LLN as well as being in due course extended with further tools and services to support the lifelong learner.

7. Conclusions

A key conclusion of the project centres upon the methodology adopted, including the use of the *trails* concept and the adoption of a user-centred approach to development. The provision of a system based specifically upon usage scenarios has proved popular with its intended users, and the evaluation has indicated that the trails concept underpinning the *L4All* system is extremely effective in practice.

Developing the *L4All* pilot has proven a challenging task, primarily because of the high heterogeneity of the different services that had to be integrated. It was sometimes necessary to extend an external service in order to cover the full *L4All* requirements (in the case of DELTA) or to write mapping code in order to translate metadata between our system and that supported by an external service (in the case of ISIS). There were also cases where it was technically not feasible to integrate an existing service as originally planned and where we had to develop our own extension to replace the missing

functionality (e.g. in the case of the visual front-end). The choice of the Flash platform for the visual front-end added extra heterogeneity, necessitating the creation late on into the project of an additional call interface through which Flash could interact with the back-end.

Through the evaluation of the pilot system, the *L4All* project has served as a catalyst for new approaches to engaging the interest of lifelong learners, developing their trust in carrying out e-learning and web-based activities, and encouraging them to take responsibility for planning and managing their own lifelong learning and continued professional development. In this vein, the *L4All* pilot provides a unique opportunity for a culturally diverse London to plan, initiate and execute a set of initiatives aimed at promoting equal opportunities, enhancing quality, accessibility and efficiency, and ensuring that new technological developments of previous JISC projects remove existing barriers and provide widening participation for all of London's learners. We are aware that the potential significance of this approach is a long-term one, involving the identification and sharing of successful educational pathways and the impact of this on learner choice. Such impact can only be studied longitudinally, and our evaluative studies will continue in the coming years, in the context of the Lifelong Learning Network, in order to provide more longitudinal findings as to impact of the system upon career choices and education decisions.

There are further improvements that we plan to make to the system in the near future: replace the Flash interface with an open-source interface that will provide better robustness, portability and extensibility; collect more information from experts in order to improve the automatic generation of sequences of courses; create an enhanced user management system that will include user groups and more advanced security rules; and integrate this with a security management system such as Shibboleth.

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