



# JISC Distributed e-learning programme

## Final Report

This document provides the final report for the L4All project.

### Project

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## Executive Summary

The main aim of the LifeLong Learning in London for *All* (L4All) project was to *support lifelong learners* in the London region, providing them with access to information and resources that facilitates their progression from Secondary Education, through to Further Education (FE) and on into Higher Education. In order to achieve this aim, the main objective of the project was to develop and evaluate a system that allows learners to access information and resources registered with the system by their providers, to plan their own learning pathways, to share experiences with their peers, and to maintain and reflect on their learning throughout life. The functionality of the system would be accessed by a Web Portal and would be provided, as much as possible, by existing JISC-funded tools and services compliant with the JISC E-Learning Framework and service-oriented architecture.

L4All represents the learning pathway of a lifelong learner as a timeline consisting of educational and career choices, critical decision steps, and factors or events that have influenced individual learner's progression and professional development. The theory behind the concept of the learning pathway as used in L4All can be attributed to Vannevar Bush's *trails* concept (1945).

The L4All team began by defining the user and technical requirements of the system. The user requirements were derived from a set of usage scenarios that were synthesised from a series of interactive workshops with targeted user groups and an ongoing consultation process with stakeholders, including Aim Higher, Connexions, Prospects and UCAS. On the basis of the identified user requirements (e.g. requested search functionality, course and timeline management features and user profile creation and editing) functionalities and various services and components were specified for the L4All pilot. The service-oriented architecture and the features of the first version of the pilot were defined and a release plan for the pilot along with features in each release phase was created.

Metadata schemas and usage scenarios of the pilot were also developed. Evaluation activities were designed to inform both design parameters (are these the right tools/functionalities to develop?) and usability issues and concerns, including accessibility (can learners use them effectively?).

Following this, the first version of the pilot was created and tested in a pilot user study. This study demonstrated at an early stage of the project that the proposed representation of learners' career and educational history could benefit lifelong learners in effectively planning their learning and work choices. The findings of this evaluation study were used to improve the functionalities in the second version of the pilot, such as searching metadata, manual pathway creation, searching learning pathways, pathway and content annotation, pathway visualisation, as well as refining the user interface.

The second version of the L4AII pilot can be conceptually divided into two levels: (i) the backend and (ii) the user interface. The backend provides connections to RDF repositories for retrieving, storing and modifying the user and course metadata, integrates external JISC services and then wraps them all under a set of web services that the user interface is able to use. The user interface consists of two parts. A web portal that acts as a platform for the user interaction components to be built upon and a Flash-based interface that interacts with the backend to provide the user functionality for creating personal timelines, searching the available courses, and searching for other users and their timelines. In its final version, the L4AII pilot integrates three external services. Two of them were developed in other JISC-founded projects: the DELTA service (Essex) for searching over the RDF metadata resources and the ISIS/ASSIS (Hull) sequencing engine for recommending next courses of study to learners. The third service was developed by University for Industry (Ufi) LearnDirect ([www.learndirect.co.uk](http://www.learndirect.co.uk)) and is used for searching and obtaining information for the full set of courses of the LearnDirect database.

The evaluation of the second version of the pilot focused upon three main user groups: Institute of Education Teacher education learners, Birkbeck College IT Applications (IT Apps) learners and FE learners from Community College Hackney. This process provided formative feedback to the team, supporting changes to the incremental prototyping of the pilot. The primary finding of these studies was the endorsement of the project concept. There was agreement across all groups of the value of this work, and its potential to support otherwise excluded groups of learners. It is particularly interesting to note the particularly positive response from the FE learners, which suggests that this might be a particularly appropriate group to focus further development work around. The evaluation study has also been useful in identifying areas that require further refinement and development. Additional functionality has also been identified that would be a valuable addition to future production version of the system, such as links to e-portfolios and/or journals.

The continuation phase of the L4AII project (April-October 2006) has undertaken further evaluation based on user studies of the L4AII pilot in order to enhance the system in preparation for its adoption, which initially will be within the HEFCE-funded Linking London Lifelong Learning Network, led by Birkbeck – see Appendix A. Studies have also been undertaken into: the requirements for organisational adoption of the L4AII system by FE/HE institutions in the London region; user modelling and profiling for further enhancement of the L4AII pilot to accommodate the needs of the individual learner; and user and technical requirements for the integration of the L4AII pilot with e-portfolio tools. A third version of the L4AII pilot has been produced at the end of the continuation phase. This version of the system is available at <http://l4all.dcs.bbk.ac.uk:8080/l4all-v3/> and the source software will shortly be made available for download from the project website at [www.lkl.ac.uk/research/l4all/](http://www.lkl.ac.uk/research/l4all/). All public project documentation relating to the L4AII project is also available from the project website.

## 1. Background

The **LifeLong Learning in London for All (L4AII)** project has focussed upon the theme of 'Supporting the independent lifelong learner'. The focus has been on helping those post-16 learners who traditionally have not participated in higher education. This problem is complex and multi-faceted but we believe, on the basis of research into life course choices, that there are two closely related issues that contribute to this situation: 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.

L4A// 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 and on into Higher Education. Emphasis has been placed upon widening participation and catering for specific needs and requirements of user communities which have been traditionally under-represented in higher education. To achieve its aims, the L4A// project has brought together a broad 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 L4A// project has built upon earlier research projects undertaken by researchers from Birkbeck and the Institute of Education at the London Knowledge Lab, including the EU-funded SeLeNe project (Keenoy et al. 2005; Peterson and Levene, 2003) and the EU-funded Kaleidoscope project (Keenoy et al. 2004a, 2004b). The L4A// pilot has also built on recent work on learning object *trails* undertaken by London Knowledge Lab researchers (Keenoy et al. 2005, 2004a, 2004b, Peterson and Levene 2003). In particular the trails concept has been developed further in the current project and has provided the basis for modelling user behaviour and informing system designs. L4A// 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.

## 2. Aims and Objectives

The project aimed to develop a pilot that would provide 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. Specifically, the pilot aimed 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 pathways;
- (iv) support in designing and maintaining personal learning and development plans;
- (v) allow learners to share information and collaborate with peers and tutors.

The following objectives were identified to achieve this aim:

- (O1) Definition of the **User Requirements, Usage Scenarios** and **Technical Requirements** of the pilot.
- (O2) **Metadata generation and provision.**
- (O3) **Development of the pilot.**
- (O4) Employment of a user-centred **Evaluation Process** that uses usability inspection methods, including user testing and heuristic evaluation, to improve the pilot so that the needs of learners and providers can be met.

The continuation project during April-October 2006 had the following objectives:

- (C1) Undertake further evaluation based on user studies of the L4A// pilot as a whole in order to enhance the system in preparation for its adoption.
- (C2) Undertake a study of the requirements for organisational adoption of the L4A// system by FE and HE institutions in the London region.
- (C3) Undertake a study of user modelling/profiling for the further enhancement of the L4A// pilot to accommodate needs of the individual learner.
- (C4) Undertake a study of user and technical requirements for the integration of the L4A// pilot with e-portfolio tools.

The above aims and objectives did not change during the project and the project has achieved all of its stated objectives, as discussed in the section on Outputs and Results detailed below.

### 3. Methodology

The methodology adopted built upon existing projects and research conducted by members of the London Knowledge Lab (Keenoy et al., 2005, 2004a, 2004b; Papanikolaou et al. 2003, Peterson and Levene, 2003).

The project was structured around a number of packages. First, the **User and Technical Requirements** were produced as part of Work Packages 3 and 4 respectively (Work Packages 1 and 2 were the Management and Dissemination work packages that lasted the duration of the whole project).

For the **User Requirements**, 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 L4AII 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 (such as age, level of literacy, ethnic minorities, special needs, accessibility requirements). The outputs of these sessions are reported in Deliverable **D3.2** and provided the basis of the user requirements and specification of the system - as included in Deliverable **D6.1**.

The initial technical requirements as stated in the project proposal were that the L4AII functionality would be accessed by a Web Portal and would be provided, as much as possible, by existing JISC-funded e-tools and services compliant with the JISC E-Learning Framework and service-oriented architecture. The L4AII **Technical Requirements** (reported in **D4.1**) were therefore elicited by (i) undertaking a study of candidate portal technologies and a critical evaluation of them that identified *uPortal* 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 L4AII; (iii) specifying a system architecture that used a selection of such e-tools in addition to *uPortal*, Apache Tomcat 5 and Apache AXIS SOAP; (iv) undertaking a study of e-learning metadata standards relevant to the L4AII application domain that identified *IMS Metadata*, *IMS-LIP* and *eduPerson* as the most appropriate standards to be used as the basis for describing the L4AII learning resources (IMS Metadata) and the L4AII users (IMS-LIP and *eduPerson*); and (v) identifying RDF and the Jena2 framework as providing a flexible, portable solution for storing the L4AII metadata.

After the specification of the User and Technical requirements, followed the **Development of the pilot** (Work Package 6) and the **Metadata Provision and Generation** (Work Package 5). A number of extensions to the standard metadata schemas were first designed in order to fully support the L4AII functionality for users and trails of learning objects, and these extensions are reported in deliverable **D6.1**. Also reported in **D6.1** is the functionality, design and implementation of the first version of the pilot.

The pilot was developed in two phases, resulting in two versions during the lifetime of the original L4AII project, and a third version at the end of the continuation phase 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 were used to make further improvements to the system before the public release of the second version for alpha testing (February 2006) and third version for beta testing (November 2006).

This first version was produced by July 2005 and incorporated the requirements identified in Work Packages 3 and 4 relating to search of learning objects (provided by DELTA), trail creation and management, searching on trails, and user profile creation and management. Further improvements were made to this first version of the pilot during the first evaluation phase during July – September 2005, relating mainly to trail creation, annotation and management. The second version of the pilot incorporated also a visual front-end and an automatic course recommendation service (based on ISIS) and was completed in February 2006. The second version of the pilot was further improved based on continued formative user evaluation during the continuation phase of the project, as detailed in Section 4.1 below.

The **Metadata Provision and Generation** work package used the L4A// metadata specification output provided by Work Package 6. Staff with responsibility for managing the information required for the L4A// metadata fields were identified within Birkbeck, the Institute of Education and Community College Hackney. Once the metadata schemas were complete, the project administrator liaised with these staff in the generation of the necessary RDF metadata for loading into the pilot's RDF repository via a simple loading tool developed by the technical team.

The **Evaluation** work package (Work Package 7) 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. The results of this evaluation demonstrated the benefits of the pilot, detected situations where the pilot did not satisfy learner needs, and identified possibilities for improvement particularly in the user interface. The outputs of the first phase helped to identify decisions 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 pilot was robust enough to cope with real-world use, it was imperative that users evaluate it to assess their acceptance, behaviour 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 different user groups – learners, tutors, widening participation officers and content providers. The feedback obtained has been used as a measure of user acceptance to undertake further necessary improvement to the pilot before releasing the final version (version 3) in November 2006. The findings of the evaluation phase are reported in deliverable **D7.2** (for the initial project) and **DC.2** (for the continuation phase).

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, making it feasible as part of the operation of a funded service but difficult to achieve within a pilot. To this end, it will be possible to undertake longitudinal studies when the L4A// system becomes fully operational within the recently formed Linking London Lifelong Learning Network.

The **Shibboleth** workpackage (Work Package 8) began with an identification of resource repository platforms and attribute schemas, in a series of meetings held with technical contacts in the partner institutions that will host end-users or access-controlled resources. Several of them do not have the technical resources needed to ensure the appropriate infrastructure for describing their users (e.g. an up to date LDAP server), and enabling such resources was not within the remit of the original project nor was it something that could be accomplished with the project resources in the timescale required for the pilot. To alleviate this situation, we concentrated on adopting an architecture that would cover the pilot only. The outcomes of this are reported in **D8.1** and **D8.2**. During the continuation phase of the project, further work was undertaken into Shibboleth enablement at Community College Hackney, led by Hackney and supported by the London School of Economics, and this is reported in Section 4.2 below.

The **Continuation Phase** of the project (April-October 2006): continued with the second evaluation phase, as discussed above and reported in deliverable **DC.2**; undertook a study of the requirements for organisational adoption of the L4A// system by FE and HE institutions in the London region, as

reported in deliverable **DC.3**; undertook a study of user modelling and user profiles in lifelong learning, for the further enhancement of the L4A// pilot to accommodate needs of the individual learner, including recommendations for personalised functionalities – reported in deliverable **DC.4**; undertook a study of user requirements and technical requirements for the integration of the L4A// pilot with e-portfolio tools – reported in deliverables **DC.5** and **DC.6**, respectively; produced a third version of the pilot based on user feedback from the continued second phase of evaluation – reported in Section 4.1 below; and undertook work into Shibboleth enablement at Community College Hackney – reported in Section 4.2 below.

## 4. Implementation

We planned the project according to a workpackage structure, where tasks and outcomes were grouped together and scheduled accordingly – please refer to the project plan for full details. As discussed in the project plan, the core project team comprised project and technical directors (G. Magoulas and A. Poulouvassilis), a project manager (S. de Freitas), a lead developer (G. Papamarkos), an administrator (F. Mohamad and subsequently L.Chan), and a user requirements and evaluation team (M. Oliver, I. Harrison, A. Mee). The core team was supported by an access management team (J. Paschoud, S. McLeish) who provided advice on Shibboleth authentication and authorisation issues. Metadata inputting and support with user studies was provided by Community College Hackney (M. Andrews, M. Marshall). The core team were joined in the continuation phase by Dr David Wilson who is a specialist in the area of adoption of information systems by organisations and who undertook the organisation adoption study reported in deliverable DC.3. Core team meetings were held every two-three weeks to review progress and plan in detail the next phases of work. Regular meetings were also held as necessary throughout the project with the broader set of partners and the advisory group. Communication with the JISC has been ongoing and as well as attending advisory group meetings, Sarah Davies has provided support to the team, communicating JISC events and providing contacts with local Learning and Skills Councils (LSCs) and Prospects.

Budget expenditure was monitored by the project directors, day-to-day administration of the project was overseen by the project manager, and administrative duties were undertaken by the project administrator.

In addition to the core team, external developers were subcontracted to undertake front-end design and development work in Flash. The main reason for bringing in external developers was due to problems with VMAP software which had originally been envisaged as being able to provide a suitable front-end but which would have needed more development time than was available in order to allow it to be integrated with our portal.

Smart space, an online collaborative tool, was used throughout the project allowing for meetings to be scheduled, documentation to be held centrally and resources to be accumulated collectively. The use of the tool significantly eased the administrative burden of the project and allowed greater flexibility in terms of part-time work schedules. We worked closely with the LKL web developer to produce the project web site (based upon a content management system), and all public documentation and other project related information was uploaded at the earliest times to facilitate good dissemination practice in line with JISC project management guidelines.

The user requirements study was based upon learner trails as a basis for developing the L4A// pilot. It was conducted from February 2005 to May 2005 and included in-depth interviews with 16+ learners from FE colleges and mature learners on the part-time IT Applications programme at Birkbeck, as well as a series of focus groups of people aiming to enter teacher education, held at the Institute of Education. In addition, an expert workshop including recruitment and career specialists and course tutors and directors from HE and FE, as well as a representative from Registry, was held at the London Knowledge Lab.

The technical work of the project concentrated on web services integration, interfacing with the uPortal framework, and on exploring the integration of services and Shibboleth components. A number of services were considered in the process of putting the portal components together. VMAP was not available as a suitable service in time, and therefore was not integrated with the portal. After consultation, we decided to design a Flash-based interface in order to provide users with easy access to the various services integrated into the pilot, and we subcontracted this activity. Open Mentor was

considered as a candidate for integration but the main problem was that it was lacking the required service-based call interface that would allow integrating it with L4A//. ISIS was incorporated into the portal and can be used to automatically recommend next courses of study. DELTA was successfully integrated into the pilot. In L4A//, DELTA searching has been combined with the Learndirect search service to provide personalised search results.

uPortal (the portal framework used in L4A//) has also proven rather problematic as uPortal is designed to be used in university portals and not in portals which are open to public access, like that of L4A//. This made the implementation of some features, such as user registration, unnecessarily difficult.

Work on Shibboleth integration with uPortal proved to be much more difficult than originally envisaged, due to the need to extend the Shibboleth architecture to permit delegated authorisation (so that portal users can be "pre-authenticated" to information delivered through portlets/channels). The first draft of the extension to the Shibboleth profiles that are needed to support this were published for comments by the Shibboleth/internet2 consortium very late in the project (October 2005), and code supporting them has not been released yet. The L4A// portal is unusual in that it does not contain pointers to large quantities of external interactive resources (in the form of servlets or channels). This means that much of the Shibboleth-related work done on portals so far has been held up to address use cases which are not themselves of importance in the L4A// context.

The evaluation process was undertaken between July 2005 and July 2006 and focused upon both first and second versions of the L4A// pilot. The first phase was undertaken between July and September 2005 and the second phase took place from March 2006 to July 2006. The evaluation process focused upon three main user groups: learners, prospective learners and careers advisors. This process provided formative feedback to the developers, resulting in corrections and improvements to the pilot. 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?).

Each of the two phases of the evaluation involved primarily usability testing methods (Nielsen 2006; Nielsen and Loranger, 2006). The first phase was aimed at providing information to the technical team to allow the development and refinement of first version of the system. Given this purpose, conventional Human-Computer Interaction methods were adopted for this phase of the evaluation. The second phase of the evaluation though adopting the same methodology also aimed to validate the pilot system by seeing whether learners and prospective learners were able to make use of the system as part of the process of choosing lifelong learning opportunities.

#### **4.1 Development of Version 3 of the pilot in the Continuation Phase**

The L4A// project has used a service-oriented architecture and has adopted the e-Learning Technical Framework described in [http://www.jisc.ac.uk/elearning\\_framework.html](http://www.jisc.ac.uk/elearning_framework.html). The L4A// pilot development has been carried out following the JISC Software Quality Assurance Policy. The project components, with the exception of the Flash-based user interface, are based on open technologies and standards, while the project code, including Flash, is well documented and open for any usage under the terms of the GNU General Public Licence.

During the continuation phase of the project, a number of improvements and changes have been applied to version 2 of the L4A// system produced at the end of March 2006 from the first phase of the project, resulting in the current version 3 of the system. These changes were mostly focused on fixing the outstanding bugs from the first phase of the project and on undertaking improvements in the Flash interface and in the service performance and behaviour – the changes are listed in Appendix B of this document.

Several recommendations for extending the system have arisen from the latest evaluation phase, which will be input into the specification of the functionality of the next version of the system, under the plans for its adoption by the Linking London Lifelong Learning Network. Figure 1 shows the final detailed system architecture of the current version of the system, version 3. We refer the reader to the earlier technical deliverable **D6.2** for a higher-level architectural overview of the system and a detailed description of each component; also discussed in that earlier deliverable is the development and testing methodology, quality assurance and technical challenges faced.

The current version of the system is available for beta testing by interested parties from <http://l4all.dcs.bbk.ac.uk:8080/l4all-v3/>.

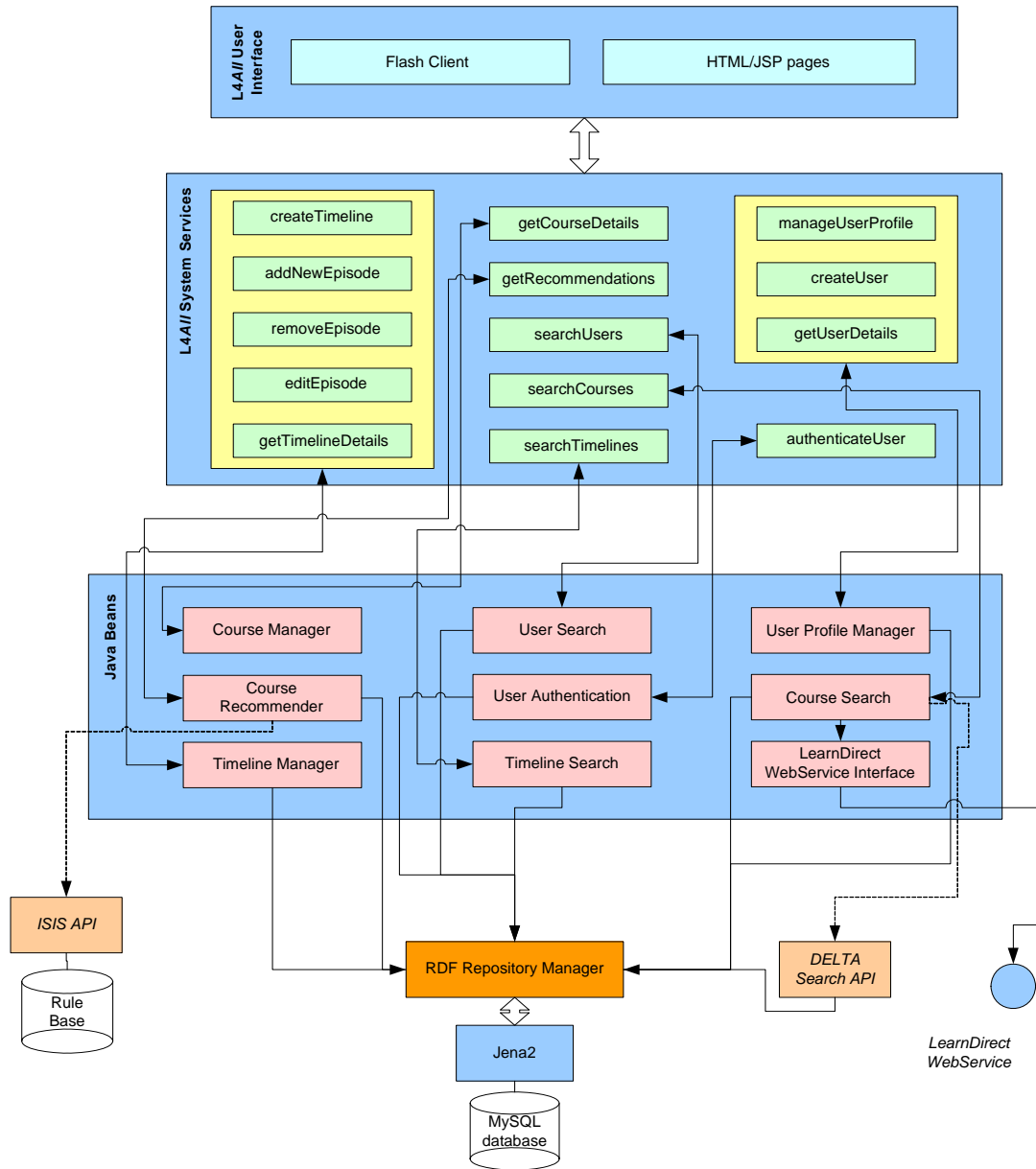


Figure 1. L4AII Detailed System Architecture

## **4.2 Shibboleth enablement at Community College Hackney in the Continuation Phase**

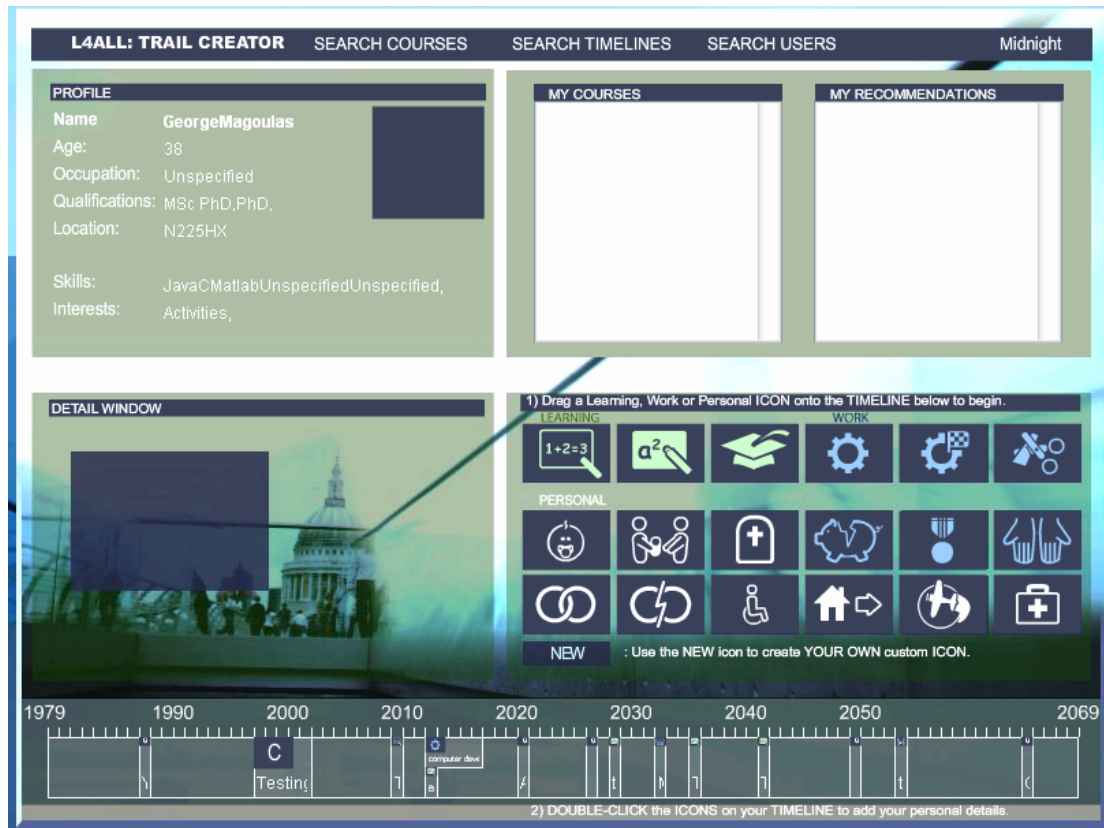
Shibboleth installation at the Community College Hackney was undertaken, led by Simon McLeish and John Paschoud from the London School of Economics. The current status is that all the software has been installed except for one item, which unfortunately has prevented overall testing of the installation. The problem is that Shibboleth uses LDAP for authentication and for obtaining the attributes for users: the possibility of copying existing user databases for Shibboleth use is not really a solution because of difficulties with ensuring replication of changing data, particularly changing user passwords. So the architecture adopted for the Shibboleth installation at Hackney was designed to use the Active Directory (AD) server already in existence to obtain user credentials and attributes. This was expected to be relatively easy, as the AD server is on up to date Windows software and this architecture is used at the LSE and several other Shibboleth installations.

However, problems were encountered with using the LDAP directory. There were initial difficulties in working out exactly how to configure connections to the directory, which were resolved with the help of one of the LSE's directory administrators. A second problem was that since LDAP on the Hackney AD is not configured to accept LDAP bind and a Linux client cannot use the Windows networking methods to connect to AD that the Windows LDAP client uses, it appeared that the connection method to use was Kerberos. The difficulty with this was that none of those involved are Kerberos experts, and it has proved difficult to see how to configure Kerberos (e.g. how to work out which piece of Windows networking configuration should be used as the Kerberos domain). Several weeks have been spent working through several collections of documents purporting to describe how to connect Kerberos on Linux to AD without success.

The best way forward at this time is to identify a Kerberos expert who can help, although they would also need to be a Windows networking expert. Once this LDAP connection problem is resolved, it should be possible to complete a successful installation at Hackney in a very short period of time.

## **5. Outputs and Results**

The project has adhered closely to its plan, milestones and deliverables. The L4AII 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. Using a broad range of technologies and standards we have build a prototype system that combines these external services, tools and resources with our own in-house customisation and development in order to provide a complete system through which the lifelong learner is able to access information about learning opportunities in the London area, create learning pathways through this information space, and search for existing pathways created by other people.



**Figure 2. User interface for timeline creation.**

With a focus upon personalising the learner's experience and in an attempt to make it easier for established and prospective learners to follow a continuous path from school to FE and onto HE and work, we argued that a more holistic approach was required. The project promoted a user-centred approach to development. This has been possible in part by scenario-based activities and through adoption of Vannevar Bush's trails concept. The resulting pilot system has produced innovative solutions for the lifelong learner in terms of supporting their education choices and career decisions, providing tools to facilitate sharing experiences through the creation of individual timelines (see Figures 2-4). This process allows the learner to reflect upon their choices and decisions and supported meta-reflection. In addition the project integrated two JISC-funded tools (DELTA and ISIS) into the L4All pilot, as well as integrated the system with the Ufl Learndirect database. We have also worked collaboratively with external developers to produce an interactive, visual front-end tool for allowing learners and tutors to create learning pathways and annotate them.

The screenshot shows the 'L4ALL: TRAIL CREATOR' interface. At the top, there are navigation links: 'MY TIMELINE', 'SEARCH TIMELINES', and 'SEARCH USERS'. A search bar contains the keyword 'ia'. Below the search bar is a table with the following data:

title	start	end	keywords
ia	1960	2010	ia, Ian Anderson
adrian	1960	2010	adrian, adrian Mee

Below the table is a 'DETAIL WINDOW' for the 'ia' entry. It contains a graphic of a whiteboard with the equation  $1+2=3$  and a green arrow pointing to it. To the right of the graphic, the text reads: 'School', 'start: 1971', and 'end: 1975'. Below this, it says 'url: undefined' and 'description: jkhhkj'. At the bottom of the interface is a horizontal timeline from 1960 to 2010, with various colored markers and labels representing different events or users.

**Figure 3. User interface for searching timelines of others**

The evaluation studies have highlighted important issues about how the tool could be used in practice to support these learners. The studies suggest that the tool could be used in a number of ways: in group careers sessions facilitated by a careers specialist, in one-to-one sessions with a careers advisor, in personal tutorial sessions, collaboratively with one or more other learners, in a class-room session with a tutor, or over the Internet from home with parents, friends, over the Internet without assistance. The flexibility of the potential usage of the tool implies that the tool could be provided via college intranet or over the Internet. It would be desirable to have the information accessible via mobile devices as well.

The learners could see why the system was useful to them and could also see ways to improve the system and make it more useful to their needs. The evaluation has therefore highlighted that the user-centred approach to development can allow for new systems to be developed according a user-centred needs and requirements.

The evaluation process has also highlighted improvements for the overall usability of the system. Some of these improvements have been incorporated into the current version 3 of the pilot while other improvements may be considered as L4All is embedded in the Linking London Lifelong Learning Network. Perhaps more interesting is the scope for new functionality as suggested by users. They are keen to see the system offer a much greater range of functionality than is presently integrated into the system, but interestingly much of this is about support of communication with other users e.g. through social software.

**L4A//: TRAIL CREATOR** MY TIMELINE SEARCH TIMELINES SEARCH USERS peternsanze

Skill:

Goal:

Age:

Occupation:

Interest:

Disability:  yes  no search

username	name
gp1	Gp
lucas	Lucas
fitri	fitri
ebretherton	Edward
alice	Alice An
ia	Ian Harr

1960 1970 1980 1990 2000 2010 2020 2030

**Figure 4. User interface for searching users with similar characteristics.**

Learners also would like to see greater opportunities for personalisation of the system through allowing them to share learning and personal content with others. More work needs to be done to integrate this type of functionality in order to give the system qualities that would make learners want to return on a regular basis – to fill in their reflective logs and journals, to update their CVs, to add photos and video clips, to chat with friends, email mentors and search for courses and jobs.

The visualisation of the timeline was particularly helpful for users implying that further resources and aspects of the system should be included based upon this design approach. Other added functionality, which was also requested in the first user studies, was to provide more information such as bus and train routes to the universities and colleges, information about open days and possibly taster courses. In this way it is thought that the L4A// resources area should be further developed using Flash animations to make them easily accessible to ESOL students and those with English reading difficulties.

The organisational adoption study undertaken in the continuation phase of the project has studied the social settings in which L4A// is expected to support learners, and other interacting software it would need in order to provide meaningful services to end-users. The study has identified mechanisms through which L4A// could be delivered in organisational settings and through which, in turn, learners could access the system for the first time. The study has identified three levels of adoption of the system by learners: firstly they will be inspired to use L4A// for immediate needs e.g. in finding the most appropriate next step in their interaction with education providers; secondly, to populate the system with their personal information; and thirdly to support their peers by forming virtual communities on the platforms provided. The study has reflected on the activities that need to be enacted to ensure the first level of adoption and to foster the second and third levels.

The study of user modelling and user profiling for lifelong learning has investigated ways to represent, store and use information about lifelong learners in the context of service-oriented architectures. It has reviewed the fundamentals of services and some widely adopted standards for representing information about the learner. It has identified learner attributes that need to be modelled for lifelong learning, and has investigated how these attributes are represented in the various metadata standards. To this end, it has used e-portfolio systems, which currently are the most common class of lifelong learning applications, as a case study. The user modelling study has explored possible dimensions of personalisation for the L4A// pilot and has proposed personalisation services that aim to accommodate the needs of the diverse user population of the system.

The integration of e-portfolio software with L4A// is particularly apposite as both have a similar ethos underpinning them. While L4A// aims to build a holistic end-to-end solution for learners using trails as advocated by Vannevar Bush (1945), e-portfolios are based on collections of electronic documents pertaining to particular aspects of an individual's professional development. Our studies of the user requirements and the technical requirements for the integration of the L4A// pilot with e-portfolio tools have reviewed the literature, current projects and software tools providing e-portfolio functionality. The user requirements study has provided a policy context for the use of e-portfolio software, has discussed different types of applications of such software, and has identified the specific requirements of L4A// users with respect to e-portfolio systems and some specific scenarios of use. The study concludes by identifying a set of user-centred issues relating to the integration of e-portfolio software with the existing functionality provided by the L4A// system. The technical requirements study has conducted a review of the major e-portfolio systems with a focus on their technical specification; has conducted a study of integrating L4A// with a specific e-portfolio system (Petal), selected based on the outcomes of this review; and has proposed some alternative approaches to integrating the two systems, at the levels of architecture, functionality and data integration. The final decision of which e-Portfolio system to choose and which integration route to follow will ultimately depend on the specific requirements of the target users of the integrated system and on the deployment environment (e.g. centralised, client-server, distributed, or a combination of these). These are issues which can be explored further within the Linking London Lifelong Learning Network within which the L4A// system will initially be deployed and within which its integration with an e-portfolio system may be piloted.

In addition to the above project outputs, the project has been successful in related academic outputs focussed on personalising learning: Sara de Freitas & Chris Yapp: "Personalizing Learning in the 21<sup>st</sup> Century", published by Network Continuum Press, 2005, brings together position papers from a seminar held by the Lab Group in July 2005 at the Design Council and includes several papers from the JISC e-learning programme contributors, and also the DEL Programme Manager Sarah Davies. Other work in the area of personalisation developed over this period (see Magoulas, 2005; Magoulas and Dimakopoulos, 2005) led to the publication of a book by George D. Magoulas & Sherry Y. Chen, entitled "Advances in Web-Based Education: Personalized Learning Environments" published by Information Science Publishing, 2006. This book covers a wide range of factors that influence the design, use and adoption of personalised learning environments.

As part of the dissemination of the project outputs, Dr de Freitas worked with representatives from a number of the other Distributed e-Learning pilot projects from South England and we held a joint final dissemination event at SOAS in London on 5th June 2006, the 'Lifelong learning for all: e-learning from concept to practice' conference ([www.gre.ac.uk/delconf/](http://www.gre.ac.uk/delconf/)). This provided an opportunity for the projects to present and demo their systems to an audience of learners, stakeholders and the wider education community of practitioners and was chaired by Dr de Freitas. Dr de Freitas and Dr Jill Jameson were also guest editors of a special issue of the British Journal of Educational Technology (BJET) on Collaborative e-support for lifelong learning (Volume 37, No. 6, November 2006). This special issue includes papers from the 'Lifelong learning for all: e-learning from concept to practice' conference, including key outputs from the South England regional pilots and a paper co-authored by the guest editors with Sarah Davies (Jameson et al., 2006). As well as a paper in this special issue (de Freitas et al. 2006a), we have published two further papers on the main phase of the L4A// project (de Freitas et al. 2006b, and Magoulas, Papamarkos & Poulouvasilis 2006) and two more papers are currently being written up resulting from the continuation phase of the project.

The L4A// project has also built up additional resources to support lifelong learners and has cemented relationships with other Distributed e-Learning Programme projects in order to disseminate findings to the wider community.

## 6. Outcomes

The project has achieved all of its stated aims and objectives. 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 (which might be developed by a number of providers), thereby encouraging progression into HE. The L4A// 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 L4A// pilot has enabled a significant input into the development of the system from major stakeholders throughout the lifetime of the project (learners, instructors, institutions and others). We believe that this methodology is also one of the major achievements of the project, and we plan to adopt it again in the JISC-funded MyPlan project that is following on from L4A// (see below), and beyond. Hosting the L4A// 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 L4A// system and this support extends to our collaboration with Linking London Lifelong Learning Network recently funded by HEFCE and led by Birkbeck (see Appendix A). With shared concerns about widening participation, social inclusion, supporting underserved learners and the use of innovation to find solutions to key challenges, the project team and the institutions see the value of working collaboratively towards the same aims and objectives. The ongoing commitment of Birkbeck to the development of the system is evidenced by funding of £5,000 secured through the Birkbeck e-learning advisory group. This has allowed us to purchase and deploy a dedicated server for the L4A// system which ensures its sustainability as a service for lifelong learners beyond the end of the project. The impact of L4A// upon the wider learning community is therefore assured.

The MyPlan project recently funded under the JISC Capital e-Learning Programme will be extending L4A// with individualised functionalities for the creation, searching and recommendation of learning pathways, and with a game-based application to give learners better understanding of the possible implications of different career decisions and educational choices (see <http://www.lkl.ac.uk/research/myplan/>). The software tools developed by the L4A// and MyPlan projects will be incrementally adopted by the Linking London Lifelong Learning Network over the next two to three years, and this Network also includes support for the further enhancement and broader deployment of the system in the longer term.

The value of the L4A// project is not only in terms of the service provided by the L4A// system for supporting lifelong learners' career and educational choices, but also as a proof-of-concept of the trails approach. In particular we have found that the trails concept that has underpinned the project provides a helpful approach for those involved in developing user-centred systems, especially when used in conjunction with usage scenarios.

The organisational adoption study has increased the value of the pilot for the consortium, the London region, and the wider education community by discussing organisational factors which affect the adoption of the L4A// pilot and identifying practical activities that need to be undertaken in order to foster the adoption of this technology by users in the partner institutions and beyond. The user modelling and user profiling study has increased the value of the pilot by identifying user attributes that need to be modelled in order to support personalised functionalities for lifelong learning, and by identifying possible dimensions of personalisation of the pilot. The studies of user and technical requirements for the integration of L4A// with e-portfolio software have increased the value of the pilot by identifying the complementary functionalities of the two kinds of system, lifelong learners' requirements of e-portfolio systems, and practical approaches to achieving architectural, functional and data integration between the two types of system.

Other outcomes of the project include progress with Shibboleth enablement at Community College Hackney, widening and strengthening the collaboration with students, peers and the wider educational community, and developing further links within the partner institutions and regional bodies.

The impact of the lessons learnt from the project have been disseminated to the wider community of practitioners and researchers through the 'Lifelong learning for all' conference in June 2006, the project website, our three publications to date (de Freitas et al. 2006a, 2006b; Magoulas, Papamarkos & Poulouvassilis 2006) and two further journal articles currently being drafted. In particular, we are interested in sharing information with the community relating to: the theory-based approach to design whereby we have used the trail concept to model users' engagement with the lifelong learning process

and to inform system designs; our experiences with developing a web service-based system to support the lifelong learner; and the outcomes of our evaluation, organisational adoption, e-portfolio integration and user modelling and personalisation studies. It is expected that other researchers, technical developers and practitioners may benefit from these outcomes.

The main project outcome has been the development of the L4A// pilot system. This system has been developed successfully and will be rolled out to members of the Linking London Lifelong Learning Network in the coming months, and also to wider stakeholder communities at the earliest stage. As part of the MyPlan project, discussions are underway with UCAS regarding integrating the L4A// system with the UCAS portal. This will benefit a very wide audience of lifelong learners through open access to learners at the critical stages of their development, helping them to make informed educational choices and career decisions. The Linking London Lifelong Learning Network will allow access to L4A// to a wide consortium London colleges and universities and will provide a good opportunity both for roll out of the current system and for the further development of tools, toolkits and services to support the lifelong learner.

Lastly, the L4A// pilot is not only a valuable resource for learners taking non-traditional pathways into Higher Education, but has also served as a test-bed of cross-institutional access management, enabling an analysis of the adoption of Shibboleth by a number of London institutions.

## 7. Conclusions

A key conclusion of the project centres upon the overall approach taken by the project team, such as 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 L4A// system is extremely effective in practice. The project advisory group have also indicated that the system is much more usable and user-friendly than other existing systems in the area and that there is strong indication that the tool will help learners to reflect more deeply upon their learning choices and career decisions.

Developing the L4A// pilot has proven a challenging task, primarily because of the high heterogeneity of the different services that had to be integrated. In some cases, it was necessary to extend the external service in order to cover the full L4A// requirements (DELTA) or to write mapping code in order to translate metadata between our system and that supported by the external service (ISIS). There were also cases where it was technically not feasible to integrate a service as originally planned (VMAP, OpenMentor) and where we had to develop our own extension to replace the missing functionality. The choice of the Flash platform to replace the visual front-end that was to have been provided by VMAP added extra heterogeneity into the system necessitating the creation of a special call interface that Flash could interact with.

The primary finding of the evaluation was the endorsement of the project concept. There was agreement across all the user groups testing the system of the value of this work, and its potential to support otherwise excluded groups of learners. It is particularly interesting to note the particularly positive response from the FE learners, which suggests that this might be a particularly appropriate group to focus further development work around.

The evaluation study has also been useful in identifying areas that require further refinement and development. Additional functionality has also been identified that would be a valuable addition to future production version of the system, such as links to e-portfolios and/or journals.

Opportunities have also been identified for interesting work with the system. For example, the possibilities for using this tool in different ways could be explored (e.g. individual use, use in formal education with an adviser or tutor, integration of this with existing services such as UCAS, etc). Another interesting observation was the way in which visualisation of learning and work prompted users to re-think their own identity as a learner (and potential employee). The long-term impact of such changes in perception on participation would be worth pursuing with longitudinal studies, possibly in the form of case analyses.

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 an 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 technological developments of previous JISC projects remove existing barriers and encourage widening participation for all of London's learners

There are further improvements that can be made to the system in the 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 recommended courses of study; 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.

## 8. Implications

Plans for the longer-term extension of the L4All pilot will aim to include a broader range of FE and HE institutions, and to have links to work-based learning environments and via the Connexions gateway. We are in discussion with Aim Higher, Prospects, Connexions and Ufl LearnDirect to find new and effective ways of embedding L4All into more generalised contexts of use and, as discussed earlier, there are specific plans and funding in place for the integration of L4All with the UCAS portal and for the adoption of the system by the Linking London Lifelong Learning Network.

The longer-term implications for the user groups targeted by the system will be a suite of tools and services that provide integrated services via college portal systems and over the Internet. Alongside these tools and services, we aim to support user communities through the availability and link up with collaborative possibilities (e.g. live chat and support of online communities). Working with the major stakeholders, the development of more joined-up end-to-end services will allow learners to more easily make educational choices and career decisions allowing them to experience a seamless movement from school to FE to HE and onto work. This will deliver a qualitative improvement to the learner and help to put their needs at the centre of the process of education and career development.

By working closely with the major stakeholders, the work conducted to date will be used to support learners in a range of different contexts e.g. via UCAS, via college and university portals, via Connexions centres and over the Internet. This wider roll out to prospective and current learners will engender widening participation particularly to those who have a restricted perception about what they can achieve in practice through learning and work opportunities.

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All public project documentation can be found at the L4A// project web pages at: [www.lkl.ac.uk/research/l4a//](http://www.lkl.ac.uk/research/l4a//).

## Appendix A – The Linking London Lifelong Learning Network

The Linking London Lifelong Learning Network has been awarded £3.7m over three years by HEFCE from their Strategic Development Fund. The Network comprises 14 HE partners and 13 FE college partners, Sector Skills Councils, the Learning and Skills Council, AimHigher, several Adult Education partners, the London Development Agency, and a number of private and public organisations.

### HE Partners

Birkbeck (lead institution)  
 City University  
 Institute of Education  
 King's College London  
 London Metropolitan University  
 London School of Hygiene & Tropical Medicine  
 Open University (London)  
 Queen Mary College  
 Royal Veterinary College  
 SOAS  
 School of Pharmacy  
 University College London  
 University of East London  
 University of Westminster

### FE Partners

City & Islington College  
 City of Westminster College  
 Crossways Academy  
 Hackney Community College  
 Kensington & Chelsea College  
 Lambeth College  
 Lewisham College  
 Morley College  
 Newham College  
 Southwark College  
 Tower Hamlets College  
 Westminster Kingsway College  
 Working Men's College

Linking London is committed to developing progression pathways and credit transfer agreements which enable learners to progress from vocational qualifications to foundation degrees and onto undergraduate degrees in the public and community services academic areas. To facilitate this, it will develop joint information systems and admissions procedures, as well as take forward opportunities for work-based learning and curriculum innovation. The network will be led by a full-time team that includes a Manager, an ICT Development Manager and several other academic, technical, administrative and management staff.

The proposed management structure will provide a high level Partnership Board with a Steering Committee and Chair (Professor John Annette). Responsibility for ongoing management of the network will rest with the Chair, the Manager and the Steering Committee. This will meet regularly and be responsible for monitoring performance against targets, and the implementation of the strategy agreed by the Board. The Steering Committee will consist of senior representatives from each partner organisation. The Partnership Board will meet less frequently, and comprise senior representatives of the institutions and external stakeholders. The Board will have responsibility for financial monitoring and provide strategic advice.

## Appendix B – L4A// Version 3

During the continuation phase of the L4A// project, a set of improvements and changes have been applied to version 2 of the L4A// system produced at the end of March 2006 from the first phase of the project, resulting in the current version 3 of the system. These changes were mostly focused on fixing the outstanding bugs from the first phase of the project and on undertaking improvements in the Flash interface and in the service performance and behaviour

The changes in the Flash interface can be grouped into two kinds: bug fixes and operational improvements, and are listed below:

(a) Bug fixes:

- In the 'Search Timelines' and 'Search Users' dialogs the following bugs were fixed:
  - i. The search operation did not work consistently. Sometimes you could get a 'Results not found' message where results did exist and sometimes the 'Search' button had to be pressed twice (or more times) for the results to appear.
  - ii. The timeline stripe on the bottom of the screen sometimes appeared correctly and sometimes did not.
- When creating a new episode on a timeline, then changing to a different window e.g. 'Search Timelines', and then going back to the timeline management dialog, the newly created episode had disappeared from the timeline. It would require closing the browser and opening the application again in order to show the newly created episode.

(b) Operational improvements:

- In the 'Search Courses' dialog the following have changed:
  - a. The 'includeLD' label was changed to 'Include Learn Direct'
  - b. The choices in 'includeLD' were converted in radio buttons.
  - c. The 'searchMode' label was changed to 'Search Mode' and radio buttons were added to the choices by replacing the AND and OR with something more meaningful for users.
- In the 'Trail Creator' dialog, we enabled episodes to happen within a single year, e.g. child birth. In the previous version, for some episodes you were wrongly required to specify a different start and end year.
- In the 'Trail Creator' dialog, the 'New' episode icon was enabled, for creating new custom episode types.
- An improved look and feel was adopted for the Flash interface.

The changes in the L4All services can also be grouped into two categories: bug fixes, and operational improvements and additions, and are listed below:

(a) Bug fixes:

- In 'Search Timelines', a bug in the service was excluding from the results a subset of timelines that did match the search criteria.
- In 'Search Users', when specifying the 'Skill' field this was wrongly being matched against the 'Occupation' field.

(b) Operational improvements:

- A parameter that clears the server cache before delivering the service results was added, in order to eliminate the problems relating to non-updated timelines in the Flash interface.
- A more detailed validity check for some service parameters was added.
- The 'getRecommendations' service was improved and was integrated with the Flash interface. This service recommends next courses for study to a user according to his/her career goal (extracted from the user profile), latest qualification gained (extracted from the user's timeline), and a set of expert-supplied rules, using the ISIS external service to perform the recommendation functionality.
- Improvements were made to the connection pooling mechanism that is used to connect with the MySQL database in order to improve the data access performance.
- Some of the error messages were made more meaningful for users.