L4*All*, a Web-Service Based System for Lifelong Learners

Sara de FREITAS [a], Ian HARRISON [a], George MAGOULAS [a],
George PAPAMARKOS [a], Alexandra POULOVASSILIS [a,1], Nicolas VAN LABEKE [a],
Adrian MEE [b] and Martin OLIVER [b]

[a] *London Knowledge Lab, Birkbeck, University of London, UK*
[b] *London Knowledge Lab, Institute of Education, University of London, UK*

Abstract. L4*All* is a system that records and shares learning trails 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. L4*All* allows learners to access information and resources registered with the system by their providers, to plan their own learning, and to maintain a record of their learning. Tutors are able to register recommended learning pathways through courses and modules, thereby encouraging progression into HE. The system allows learners to share their learning plans and experiences with other learners (if they wish) in order to encourage collaborative formulation of future learning goals and aspirations.

Keywords. Lifelong Learning, Web Services.

Introduction

The **L4*All*** "LifeLong Learning in London for All" project[2] was funded under the JISC Distributed e-Learning Programme[3] and focussed on supporting the 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.

L4*All* aimed to provide lifelong learners in the London region with access to information and resources facilitating their progression from Secondary Education, through to Further Education (FE) and on into Higher Education (HE). To achieve its aims, the L4*All* project 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 L4*All* project was 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).

The L4*All* pilot system allows learners to record their past learning, and more generally life, experiences as well as their planned future learning experiences along their "timeline", which is managed by the system. As an aid to constructing their timeline, learners are able to search through learning opportunities registered with the system by their providers. Learners are able to access the timelines of other learners (if these have been made public by their owners) and also to access recommended learning pathways through courses and modules, as provided by tutors. 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 follow-on project **MyPlan**[4] **"**Personal Planning for Learning Throughout Life" is aiming to increase the value of the L4*All* pilot by researching, developing, deploying and evaluating user models for lifelong learners, and personalised functionalities for creation and search of timelines and recommended learning pathways. The following sections of the paper address the aims and objectives of the L4*All* and MyPlan projects to date, methodology, development approach and technologies used, results, outcomes and finally conclusions and directions of future work.

1. Aims and Objectives

The L4*All* project had 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, recommended 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 L4*All* project in order to achieve these aims:

- Definition of User Requirements, Usage Scenarios and Technical Requirements;
- Metadata Generation and Provision;
- Development of the Pilot;

---

[4] http://www.lkl.ac.uk/research/myplan/

- 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.

The follow-on MyPlan system includes the following additional objectives:

- Development of User Models and a User Modelling Ontology for planning of lifelong learning;
- Specification, development, deployment and evaluation of personalised functionalities for planning of lifelong learning.

2. Methodology

The L4*All* 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 learning *trails* (Bush, 1945; Peterson and Levene, 2003). In our context, a "trail" is a sequence of learning opportunities, experienced over time by a learner. We believed at the outset of the L4*All* project that a timeline-based representation of learners' work, learning and other life experiences could provide a holistic approach to learners' life experiences 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 L4*All* 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 L4*All* 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 L4*All* project was funded by the JISC Distributed e-Learning Programme[5], which mandated that (i) systems developed under the programme should use, as much as possible, existing e-tools and services provided by other JISC-funded projects, and (ii) systems should be compliant with the JISC E-Learning Framework and service-oriented architecture[6].

In our case, the detailed Technical Requirements were elicited by: (i) undertaking a study of candidate portal technologies and a critical evaluation of them that identified

---

[5] http://www.jisc.ac.uk/programme_edistributed.html

[6] http://www.jisc.ac.uk/index.cfm?name=elearning_framework

uPortal [7] 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 L4*All*; (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 L4*All* application domain that identified *IMS Metadata* [8], *IMS-LIP* [9] and *eduPerson* [10] as the most appropriate standards to be used as the basis for describing the L4*All* learning resources (IMS Metadata) and the L4*All* users (IMS-LIP and eduPerson); and (v) identifying RDF and the Jena framework[11] as providing a flexible, portable solution for storing the L4*All* metadata.

The Development of the Pilot, and the Metadata Provision and Generation phases followed the specification of the User and Technical requirements. A number of extensions to the standard metadata schemas were first designed in order to fully support the L4*All* functionality, namely metadata describing learners' timelines 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 L4*All* 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 then used to make further minor adjustments to the system and also led into the follow-on MyPlan project.

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[12]), creation and management of learners' timelines, searching on timelines, 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 timeline management. The second version of the pilot incorporated also a visual front-end and an automatic course sequencing service, using the ISIS sequencing engine[13], and was completed in February 2006.

The Metadata Provision and Generation work package took as input the L4*All* metadata specification produced earlier. Staff with responsibility for managing the information required for the L4*All* 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.

As mentioned earlier, the Evaluation work package was organised in two phases. The first phase involved consultation with student representatives, tutors, widening

---

[7] www.uportal.org

[8] http://www.imsglobal.org/metadata/

[9] http://www.imsglobal.org/profiles/

[10] http://www.educause.edu/eduperson/

[11] http://jena.sourceforge.org

[12] http://www.essex.ac.uk/chimera/delta/index.html

[13] http://www.hull.ac.uk/esig/isis.html

participation officers and content providers, and conventional Human-Computer Interaction methods were adopted.

The second phase adopted heuristic evaluation methods focusing upon usability issues, as defined by Nielsen (2006) and Nielsen and Loranger (2006). This second evaluation round took 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 centred upon three main user groups: FE learners from Community College Hackney (6 users), professional learners on the Certificate/Diploma in IT Applications at Birkbeck (16 users), and Teacher Education learners from the Institute of Education (12 users). 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 this second phase was used as the basis for undertaking further minor improvements to the pilot, and also led into the follow-on MyPlan project.

On the basis of the original user requirements from the L4*All* project, from its evaluation, and from other lifelong learning applications, we have now conducted initial work within the MyPlan project to produce a first version of user models, covering user preferences and characteristics in planning their lifelong learning, and a first version of a user modelling ontology.

We have also produced a specification of the personalised functionalities for planning of lifelong learning, which are currently under development within a new "personalisation engine". The personalisation engine is providing personalised search of timelines from "people like me", personalised recommendation of which course(s) to study next; and customisation of the delivery and presentation of content. Its development is currently reaching completion and it is under internal testing before being transferred to the server that will be used for the online evaluation and user testing towards the end of 2007/early 2008.

The personalisation engine incorporates a set of similarity measures for comparing learners' timelines, based on converting timelines into strings of comparable tokens and using string metrics for ranking them. For the recommendation functionality, we are planning that tutors' recommended learning pathways entered into the system will be encoded similarly and will be compared with learners' timelines to propose matches. Several customisation features have also been developed to date (colour/shapes used in the timeline visualisation, bookmarks for interesting timelines, etc.).

The MyPlan project has also redesigned the original Flash-based user interface of the L4*All* pilot system using DHTML and javascript-powered widgets to deploy users' timelines. This decision is allowing us to improve the possibilities of learners' interaction with their timeline (such as maintenance of their own timeline and also comparison between their timeline and someone else's) and therefore to better support personalisation of timeline-based functionalities.

3. Development approach and technologies

The L4*All* system consists of a set of components and services. The architecture comprises two parts: (a) the backend and (b) the user interface. In the current version of the system, the user interface is a Web portal deploying several DHTML pages that interact with the backend and present to the user the L4*All* functionality relating to the
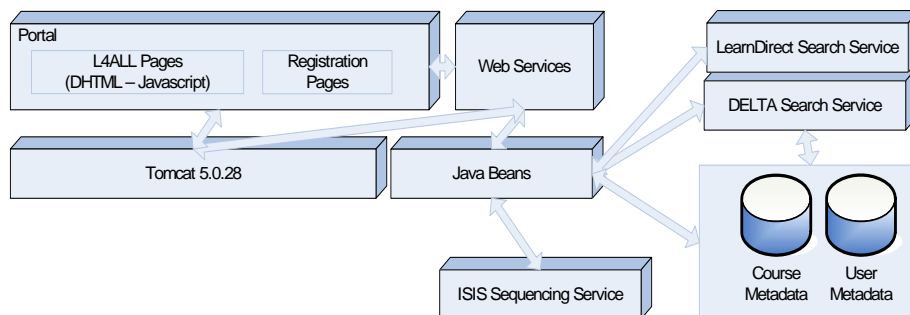
Figure 1. L4*All* system components

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 (see Section 2) and a service for search and retrieving information about courses in the LearnDirect database[14].

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.

4. Results to Date

The L4*All* pilot has achieved almost all of the user requirements identified in the early part of the L4*All* 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 L4*All* 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.
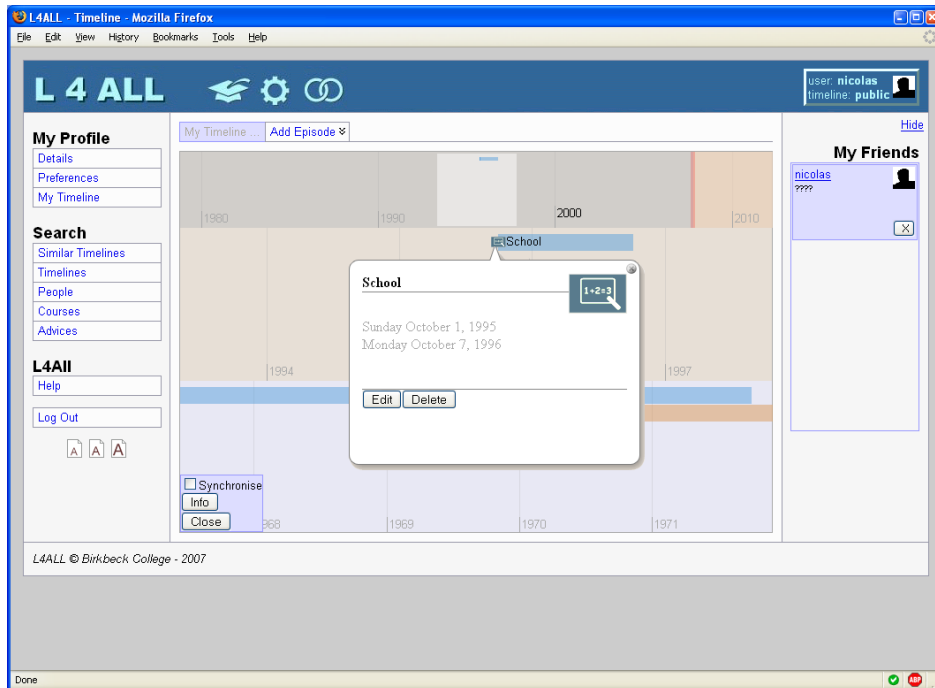
---

[14] http://www.learndirect.co.uk/

Figure 2. The main interface of the L4All web portal.

Figure 2 shows the main screen for the creation and visualisation of timelines, the central access point of the portal. In the top right-hand box appears a brief description of the user's details. On the left-hand side of the screen is where the various functionalities of L4*All* are available: modifying the user's profile and preferences, searching for courses, people or timelines, exploring learning pathway recommendations, etc. In the middle of the screen, the user timeline is accessible through a dynamic multi-stripe. On top of it, a popup menu ("Add Episodes") provides a rich set of predefined episodes (e.g. courses, university, work, travel, marriage) that can be chosen to be placed within the user's timeline. The user can choose from this set of episodes, create a new custom episode, or include courses resulting from his/her searches.

The visualisation of the timeline is currently provided by a DHTML widget (the SIMILE timeline[15]) which displays time-based events in a scalable and scrollable fashion. Each event in the timeline is materialised by a rectangular shape spreading from the start date to the end date of the event. Clicking on an event displays popup balloon dialog which presents a short summary of the event (see Figure 2). By clicking on the edit button in that balloon, the user accesses a new dialog box (see Figure 4) for the user to modify the details of the episode. Saving the episode in the timeline initiates (transparently to the user) a synchronisation of the visual front-end with the databases at the backend.
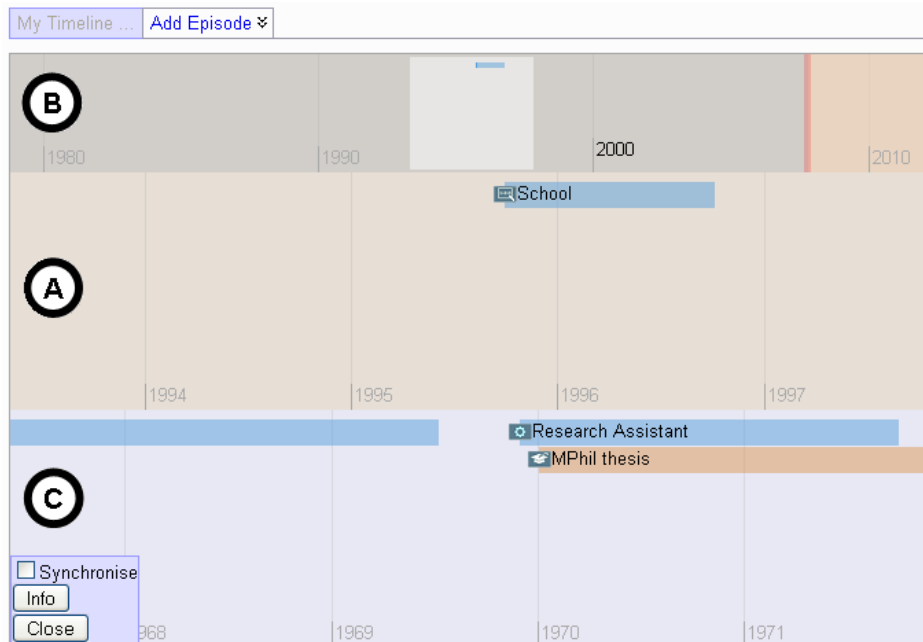
---

[15] http://simile.mit.edu/timeline/

Figure 3. Synchronised visualisation of two timelines, the current user's one (top and middle) and that of a second user (bottom).

The middle stripe (labelled A in Figure 3) is the user's timeline, presenting episodes that have been added over the user's repeated usage of L4*All*. The top stripe (labelled B) is a reduced version of the main stripe, with a different time scale (usually a decade), allowing an overview of the whole timeline and a quicker scroll-across time. Both timelines can be dragged forward and backward in time and remain synchronised (the time frame visible in the user main timeline is indicated in the summary by a lighter zone).

The bottom stripe (labelled C) is an optional timeline that is activated on demand by the user, usually by searching for other people in the L4*All* system and displaying their timelines. This timeline only displays episodes that have been made public by the owner. Both timelines (the user's and the friend's) can be synchronised by date (scrolling the user's timeline will modify the friend's accordingly) or allowed to be independent, hence allowing the user to explore the friend's timeline and extract information, inspiration or examples of learning activities to plan.

The user can search for courses by clicking on the SEARCH COURSES link in Figure 2. 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 a pop-up window, from where they can be explored in detail and added to the timeline.
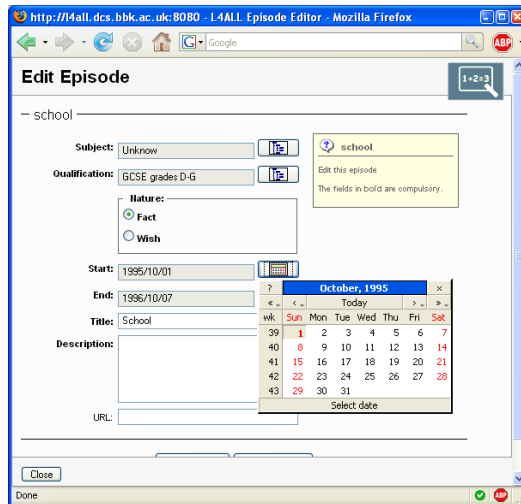
Figure 4. Editing an episode of the timeline.

Clicking on SEARCH TIMELINES in Figure 2 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 PEOPLE in Figure 2 again opens a window for search for users via a set of search criteria including skills, qualifications, interests, age and occupation.

More interestingly, clicking on SEARCH SIMILAR TIMELINES allows users to perform a personalised search in the L4*All* system by looking for 'people like me'. The definition of 'people like me' being a highly subjective concept, users are presented with an interface for specifying their own criteria (see Figure 6).
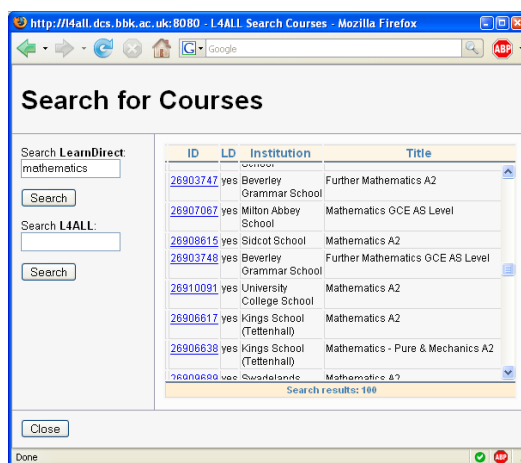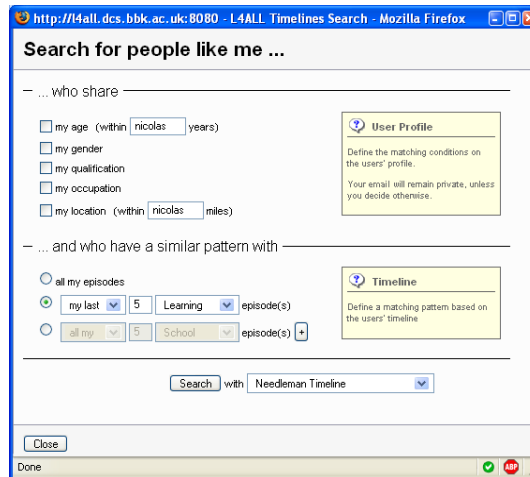

Figure 5. Searching for courses in L4*All*.

Figure 6. Searching for similar timelines.

By specifying matching criteria on their user profile (e.g. age within a certain range, gender, current occupation, etc.) and matching patterns on their timelines (e.g. considering all episodes, considering only educational or professional episodes, considering only the last 5 professional episodes, etc.), users can define a personalised search space that is matched against all the timelines and users stored in the system. The results, ranked according to their relevance by using string-based similarity measure techniques, are presented to the user, who has the possibility to display appropriate timelines in the main visualisation screen and explore them.

Finally, Figure 7 illustrates the screen for entering or modifying the user's profile and learning preferences while Figure 8 illustrates the screen for customising the display of a user's timeline.
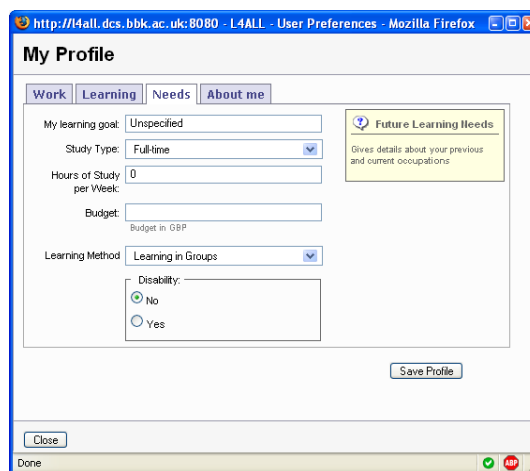

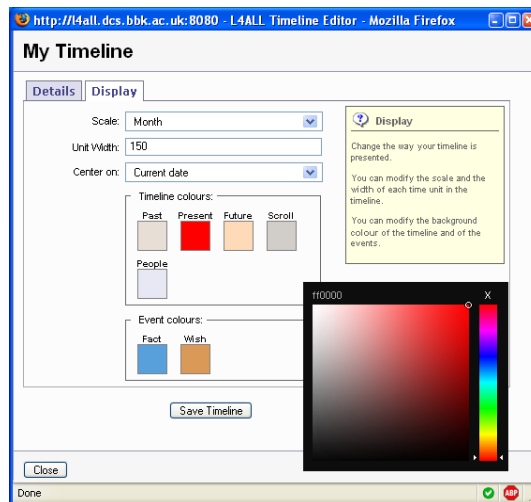**Figure 7**. Editing the user's profile.

Figure 8. Customisation of the timeline visualisation

5. Outcomes and Conclusions

The second evaluation phase (of version 2 of the L4*All* system) centred upon usage of the functionality provided by the system. Users were invited to complete a range of tasks and after completing these tasks to reflect upon these activities in 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 finding of the second evaluation phase has been the overall endorsement of the L4*All* 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 FE learners suggesting that this might be a group that will benefit particularly from L4*All*. The evaluation study was also useful in identifying areas of further technical refinement and development that are required in the future 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.

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. The methodology enables a significant input into the development of the system from major stakeholders throughout the lifetime of the project (learners, instructors, institutional representatives and others).

To our knowledge, the holistic approach to life and learning experiences provided by L4*All* is novel and unique. The services-oriented approach has allowed several existing services to be incorporated into the system's functionality to date, with the possibility of further extensions in the future, for example with e-portfolio and social networking services, and this is part of ongoing research within the follow-on MyPlan

project. This is the chief advantage of a services-oriented as opposed to a monolithic development approach, namely the possibility of reuse, aggregation and extension of existing services within the broader sphere of lifelong-learning support.

The potential educational significance of the system is a long-term one, involving the identification and sharing of successful educational experiences 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 HEFCE-funded Linking London Lifelong Learning Network (L4N) led by Birkbeck, in order to provide more longitudinal findings as to the impact of the system upon career choices and education decisions. Our objectives for the next phases of the ongoing MyPlan project include:

- validating the design of the first version of the personalisation engine through its evaluation with small groups of lifelong learners selected via partner institutions in the L4N;
- investigating the possibilities of integrating a game-based tutorial for lifelong learners with the system.

The L4N has created new drivers for change to accommodate the needs of learners moving between various groups and institutions. A MyPlan project workshop took place in May 2007 and brought together several key stakeholders in lifelong learning. The workshop identified, in confirmation of previous outputs of the L4*All* user evaluation, the need for supporting user engagement and participation in lifelong learning, and stressed the importance of facilitating collaboration among lifelong learners for community building. So lifelong learners require support not only at the level of the individual user but also at the level of a group or team, and of the community. The results of deploying the system within the L4N and of its evaluation with different groups of users will in the longer term be able to inform the formulation of policies for engaging the interest of lifelong learners.

References

[1]   Bush, V. (1945). As we may think. Atlantic Monthly, 176, 101-108.

[2]   Keenoy, K., Levene, M., de Freitas, S., Montandon, L., Pernin, J-P., Eyssautier, C., Jones, A., Brasher, A. and Waycott, J. (2004a). Personalised trails and learner profiling in an e-learning environment. EU Kaleidoscope Trails Deliverable 22.4.1. See: http://www-kaleidoscope.imag.fr/pub/trails/ .

[3]   Keenoy, K., Levene, M., de Freitas, S., Montandon, L., Emans, B., Schoonenboom, J., Pernin, J-P., Eyssautier, C., Jones, A., Brasher, A., Waycott, J., Turcsanyi-Szabo, M. and Bodnar, E. (2004b). Collaborative trails and group profiling within an e-learning environment. EU Kaleidoscope Trails Deliverable 22.4.2. See: http://www-kaleidoscope.imag.fr/pub/trails/

[4]   Keenoy , K., Poulovassilis A., Christophides V., Rigaux P., Papamarkos G., Magkanaraki A., Stratakis M., Spyratos N., Wood P., (2005). Adaptive Personalisation in Self e-Learning Networks, 1st International Workshop on Distributed e-Learning Environments (held in conjunction with the 1st International ELeGI Conference on Advanced Technology for Enhanced Learning), Naples, March 14, 2005.

[5]   Magoulas G.D. and Dimakopoulos D.N. (2005) Designing Personalised Information Access to Structured Information Spaces, Proceedings of the Workshop on New Technologies for Personalized

Information Access, 10th International conference on User Modeling, July 24-29, 2005, Edinburgh, Scotland, UK, 64-73.

[6] Nielsen, J. (2006) .Ten usability points. Last accessed10th March 2006 online at: http://www.useit.com/.

[7] Nielsen, J and Loranger , H. (2006) Prioritizing Web Usability. New Riders Press, Berkeley.

[8] Papanikolaou, K., Grigoriadou, M., Kornilakis, H., and Magoulas, G.D., (2003). Personalising the Interaction in a Web-based Educational Hypermedia System: the case of INSPIRE, User-Modeling and User-Adapted Interaction, vol. 13, 213-267.

[9] Peterson, D. and Levene, M. (2003). Trail records and navigational learning. London Review of Education, 1, 207-216.