



Final Report

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Executive Summary

The MyPlan project aimed to contribute to the JISC e-Learning programme by developing, deploying and evaluating new techniques and tools that allow personalised planning of lifelong learning. The project brought together stakeholders from a broad range of institutions all of whom are committed to providing lifelong learning opportunities which enhance career development and widen participation. These stakeholders contributed to the formulation of user and technical requirements, and the evaluation of the tools developed by the project. The project had three major aims:

- (i) development and evaluation of learner models and an ontology for learner modelling in a lifelong learning context;
- (ii) development, deployment and evaluation of personalised functionalities for the creation, searching and recommendation of learning pathways;
- (iii) development and integration of a game-based application into the system, to give learners better understanding of the possible implications of different career decisions and educational choices.

The project ran for 27 months, starting on 1st September 2006 and ending on 30th November 2008. It produced two successive versions of new personalised functionalities for lifelong learners. The software developed is in the form of components and services that extend the existing L4A// system. A key feature of the project were our frequent engagements with users (several student groups from FE/HE institutions) and user stakeholders (the tutors of these groups, the project Advisory Group and project Partners, the JISC programme manager). These engagements were invaluable in informing the design of the system, and the aims and methodology of the evaluation sessions.

The project has developed and evaluated new techniques and tools to support personalised planning of lifelong learning. A personal space for lifelong learners such as this contrasts with many other learning environments, which provide learners with resources and learning management tools that relate to their study at a single institution. The project's deliverables (available from the project website) report on the design and development of the new techniques and tools produced by the project, and on several evaluation sessions that were undertaken with groups of FE/HE learners.

With respect to the project's first aim, we developed a Lifelong Learner Ontology (LLO) that aims to capture the key attributes relating to lifelong learners. We also designed an architecture to support interoperability of learner models across different service-oriented educational systems, which leverages the LLO and other heterogeneous data integration technologies. We developed several usage scenarios in order to validate successive versions of the LLO.

With respect to the project's second aim, we developed a method, based on string similarity measures, for identifying the degree of similarity between the timelines of two users. This method underlies the new "people like me" and "what next" functionalities that we developed. We also completely redesigned the L4A// system's interface. Much positive feedback about the enhanced L4A// system was received from students participating in the evaluation sessions.

With respect to the project's third aim, a review of current games applications and related activities being used to support lifelong learners was undertaken, the requirements for a game-based application to fit the user groups targeted by the MyPlan project were identified, and a study of using Second Life for supporting FE/HE learners with their career and education choices was undertaken. A list of practical guidelines for tutors aiming to use Second Life emerged from this study.

Lifelong learners constitute a diverse student population. Personalised technologies such as those developed by this project can assist lifelong learners to formulate and manage their learning plans under varying circumstances and settings. The use of an ontology-based approach to support personalised planning of lifelong learning provides a holistic view for the learner of their learning and career trajectories, and also an integrated view of all aspects of a learner's information that will enable different systems to provide more effective support learners in the formulation of their learning and career goals and information needs.

Background

The Lifelong Learning in London for All (L4A//) project funded by the JISC Distributed e-Learning Pilot Call developed a system to support lifelong learners in exploring learning opportunities in the London region and in planning and reflecting on their lifelong learning activities. This earlier project (see www.lkl.ac.uk/research/l4all/) targeted Theme 3 of the DEL pilot call, "Supporting the independent lifelong learner", and its aim was to allow learners to record and share learning pathways through educational offerings, thereby facilitating progression from secondary education, through to Further Education (FE) and on into Higher Education (HE). The L4A// system provides a Web Portal 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 learning.

Learners can share their learning pathways with other learners (if they wish) in order to encourage collaborative learning and collaborative formulation of future learning goals and aspirations. The focus is particularly on those post-16 learners who have traditionally not participated in higher education. The aim is for potential educational pathways to be identified, providing a repertoire of possibilities that learners may not otherwise have considered, and positioning successful individuals as role models to inspire confidence and a sense of opportunity amongst those previously excluded.

The L4A// project developed basic infrastructure to support lifelong learners in exploring learning opportunities. The L4A// user interface provided screens for user registration and login; entering personal details relating to past and present occupation, skills, qualifications, interests and future learning goals; for creating personal 'timelines' incorporating past and future episodes of learning and work; and for searching over courses, over timelines made sharable by other users, and for other users of the system, in each case based on a variety of search criteria.

Evaluation of the L4A// pilot undertaken with groups of learners from FE and HE found that learners enjoy using the system, that it helps them adopt a holistic view of their educational and career prospects, and that it has the potential to provide significant support for making career decisions and educational choices.

However, the evaluation has also identified two key areas where further work was required: **personalisation** of the learning planning and recommendation functionalities, and **improved support** for users of the system, particularly for new users. To this end, the MyPlan project targeted the following aims and objectives.

Aims and Objectives

- To develop, deploy and evaluate **user models** that reflect the needs of the diverse population of lifelong learners. We planned to identify learner attributes that need to be modelled and tasks/activities undertaken by lifelong learners, e.g. making career and educational choices, maintaining learning pathways throughout life, sharing information with peers and tutors. This information would be used to develop an ontology for user modelling in a lifelong learning context.
- To develop, deploy and evaluate **personalised functionalities** for the creation, searching and recommendation of learning pathways. This would enhance individual learners' engagement with the lifelong learning process by offering personalised levels of learner control over their learning pathways, personalised support in the reflection of where their learning activities may take them, and management of their personal record of progress and attainment. It would also support building communities of learners with similar interests, and information sharing with other members of the community, other users of the L4A// system, and organisations.
- To evaluate current game-based applications for supporting lifelong learners with view to developing and integrating a **game-based application** into L4A//. This would allow learners to role-play different learning and career progressions in order to give them better understanding of the possible implications and consequences of different career decisions and educational choices.

These aims and objectives did not change during the project, except for the last one, which was reoriented somewhat (after discussion with, and approval by, the Programme Manager) so as to not undertake development of a new game-based application but instead to host structured activities within Second Life in order to support virtual work experience and e-mentoring of learners.

Methodology

The MyPlan project ran for 27 months, starting on 1st September 2006 and ending on 30th November 2008. It has produced freely available open-source software, including two successive versions of the personalised functionalities for lifelong learners. The software developed is in the form of components and services that extend the previous L4A// system. The L4A// user interface has also been replaced by DHTML/javascript technologies (it was previously Flash), as the original interface did not offer the necessary flexibility to incorporate the additional personalised functionalities that were the focus of this project.

The methodology we adopted in designing, developing and evaluating these new components of the L4A// system enabled a significant input from major stakeholders throughout the lifetime of the project (learners, instructors, project advisors, JISC and others). Hosting the project at the London Knowledge Lab 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 and Institute of Education institutions) with FE/HE institutions and stakeholders.

The three major aims of the project listed above were addressed by 6 Workpackages:

WP1: Management, administration and dissemination. This addressed all aspects of management and administration of the project, and dissemination of outcomes. Regular meetings of the core team were held every two-three weeks, supported as necessary by the project administrator, who also maintained the project website, and assisted in the organisation of dissemination events. The Advisory Group met with the whole project team several times during the project, providing guidance on user and technical requirements, usage scenarios, evaluation, longer-term scalability, and likely impact on increasing uptake of degrees especially amongst groups who have been under-represented in HE.

WP2: Development of User Models and a User Modelling Ontology for personalisation. The user requirements arising from the L4A// project and from its evaluation informed initial work in this WP to produce a first version of user models covering user preferences and characteristics in planning of lifelong learning, and a first version of a Lifelong Learner Ontology. Additional users' attributes were identified through the analysis of lifelong learners' tasks and activities, and several usage scenarios were designed. This work informed further development of the Lifelong Learner Ontology into its final form, which aims to facilitate the exchange of learner data between L4A// services, and also the interoperability of such services with other applications in the future. *Deliverables: D2.1 Preliminary report on Ontology development for MyPlan; D2.2 Final report on Ontology development for MyPlan.*

WP3: Specification of personalised functionalities for planning of lifelong learning. This work was informed by the user requirements arising from the earlier L4A// project, the L4A// evaluation, and the early work on WP2. We surveyed personalisation in lifelong learning, the different kinds of advice and guidance for learners, and hence the different kinds of possible personalisation. We then analysed the personalisation requirements of the L4A// system and, building on this requirements analysis, we specified the personalisation functionalities that would be researched, developed and evaluated in the MyPlan project. We also identified the necessary extensions to the current L4A// system architecture to support these new personalisation functionalities. *Deliverable: D3.1 Personalisation Specification.*

WP4: Development and deployment of personalised functionalities for planning of lifelong learning. This WP developed two successive versions of the enhanced L4A// system. The new components and services extended the current L4A// system architecture, and also replaced the previous user interface with more flexible DHTML/javascript technologies. The software continues to be compliant with the JISC e-Learning Framework and service-oriented architecture, and to use and extend as necessary learning object and learner metadata based on the IMS Metadata (<http://www.imsglobal.org/metadata/>), IMS-LIP (<http://www.imsglobal.org/profiles/>) and eduPerson (<http://www.educause.edu/eduperson/>) standards. The first version of the enhanced system took as input the specification from WP3 and the early phases of work on WP2. We designed and developed the new GUI, new personalised search for "people like me", and new customisations of the delivery and presentation of contents. Evaluation of V1 was undertaken in WP5 (see below). Work also began on studying how the extended L4A// functionality could be integrated with the UCAS web portal, steered by Geoff Ramshaw from UCAS. Version V1 was then extended and enhanced with a new personalised recommendation system taking as input the more mature outputs from WP2, and the

results of the ongoing evaluation in WP5. The second, final, version V2 was delivered towards the end of the project. *Deliverables: D4.1 Report on the development of version 1 of the Personalisation Engine; D4.2 Report on integration of L4All with the UCAS web portal; D4.3 Report on the development of version 2 of the Personalisation Engine.*

WP5: Evaluation. Two phases of evaluation were undertaken, using respective versions V1 and V2 of the system. The first phase involved a group of FE learners at Community College Hackney and a group of mature learners on skill-based courses at Birkbeck. This first phase aimed to assess the impact of our design decisions for the “searching for people like me” functionality. The feedback from these evaluations was analysed and the results informed the enhancement and extension of the system towards V2. The second evaluation phase involved two groups of learners on Foundation Degrees, the first group at Birkbeck and the second group at the College of North East London, who were members of the L4N. This second evaluation phase aimed to assess the effectiveness of the system in supporting the planning of lifelong learning, and to assess the impact of our design decisions for the “what next” functionality. *Deliverables: D5.1 Preliminary evaluation report. D5.2 Final evaluation report.*

WP6: Game Application. This workpackage was undertaken by Prof Sara de Freitas from Coventry University’s Serious Games Institute (SGI), as an independent contractor. An evaluation was undertaken of current game-based applications for supporting lifelong learners, and the most appropriate approach to pursue for the MyPlan project was identified as being the use of a virtual world application such as Second Life. A study of using Second Life for supporting learners with career/educational choices was then undertaken: two Learning Day sessions were devised to highlight main issues arising from this mode of learning and to aid with producing guidelines for tutors aiming to use such tools; the two sessions were held with student groups from Birkbeck and Community College Hackney, and involved visits to the UCAS, SGI and IBM islands, facilitated by a Mentor. *Deliverables: D6.1 Report on the specification and development of the Game Application; Deliverable D6.2 Report on the user studies and evaluation of the use of Second Life for the MyPlan project.*

Implementation

The work followed the workpackages planned at the outset of the project, as described above. Two developers were appointed, as planned, Dr Nicolas Van Labeke who had primary responsibility for the work in WPs 4 and 5, and Hassan Baajour, who had primary responsibility for the work in WP2. The project’s progress followed the timescales that had been originally envisaged, but with a slippage of a few months in the delivery and evaluation of V1, due to the additional work on the L4All User Interface that it quickly became apparent would be necessary in order to meet the project’s objectives. Fortunately, we were able to realign somewhat the original budget expenditure so as to allocate several more months to the lead developer post (held by Dr Nicolas Van Labeke) in order to enable this additional work on the GUI to be undertaken.

A key feature of the project were our frequent engagements with (i) users (several student groups from FE/HE institutions) and (ii) user stakeholders (the tutors of these groups, the project Advisory Group and project Partners, the JISC programme manager). These engagements were invaluable in informing the design of the system, and the aims and methodology of the evaluation sessions.

We held regular meetings of the core project team every two-three weeks, we circulated early drafts of documents for comment by, and input from, other team members, and we maintained the project website up-to-date with new content at all times. All of these measures ensured very good communication between all members of the team on the progress of the work, so that planning and decision making were well-informed at all times.

We held four meetings of the Project Advisory Group and team members, approximately one every 6 months. These discussions were instrumental in providing longer-term steerage for the design and evaluation of the system, and as such were also very valuable. In particular, the meeting held on 30/4/2008 was instrumental in refocusing our planned approach to the course recommendation mechanism. Two considerations arose from that meeting. Firstly, that the terminology used for this facility needed to be carefully considered: “recommendation” is a strong term related with career advice, which is not what the L4All system aims to provide. A more neutral term – such as “what next” – was agreed upon as being more appropriate, especially since the mechanism we were proposing to

implement would be supporting the user in exploring others' timelines in a particular way (i.e. *"this is what people have done after following a pathway similar to yours; why not consider a similar future?"*). Secondly, the source of information to use for this "what next" functionality needed to be feasible from a pragmatic viewpoint. Our initial proposal (reported in Deliverable 4.1) was to provide a template-based version of a timeline, not representing full timeline information, but consisting of a chain of episodes that could be viewed as a sequence of prerequisites and a final goal. Such an approach may be adequate in overcoming the lack of formal connections between episodes within timelines, but does it does however have practical limitations in the sense that it needs significant expert effort in building up a repository of such templates for the full learner community. The recommendation from the meeting on 30/04/2008 was to leverage instead the repository of users' own timelines in order to present possibilities of "what next" to individual users, building on the timeline alignment mechanism that had already been developed. This is indeed the approach that we adopted for V2 of the system, and it is described in Deliverable 4.3.

Outputs and Results

MyPlan has developed and evaluated new techniques and tools to support personalised planning of lifelong learning. A personal space for lifelong learners such as this contrasts with many of the learning environments currently in use, which provide learners with resources and learning management tools that relate to their study at a single institution. The project has brought together stakeholders from a very broad range of institutions all of whom are committed to providing lifelong learning opportunities which enhance career development and widen participation. These stakeholders have provided input into the formulation of the user and technical requirements and the evaluation of the tools developed by the project. In particular, evaluation sessions were undertaken with FE learners from Community College Hackney and College of North East London, and HE learners from Birkbeck.

The project's deliverables report on the design and development of the new techniques and tools produced by the project, and on their evaluation:

- Deliverables 2.1 and 2.2 report on the Lifelong Learner Ontology (LLO) that we developed, on several usage scenarios that we developed in order to validate and improve this ontology, and on a service-based broker architecture for learner model interoperability.
- Deliverables 3.1, 4.1, 4.3 report on the specification, design and development of the new GUI and the new personalisation functionalities added to the original L4A// system, namely (i) personalised search of timelines from "people like me" (where users themselves can select from a broad range of attributes which ones they consider meaningful in this search), (ii) personalised identification of possible next courses to consider for further learning/career development, and (iii) customisation of presentation and delivery of content (e.g. colour/shapes used in the timeline visualisation, bookmarks for interesting timelines, a link with the GoogleMap API to display the locations of users, of particular episodes, of course providers, and for computing distances between locations).
- Deliverable 4.2 points to possible approaches to integrating the L4A// system with the UCAS web portal, and on 5 new usage scenarios for learners that would be supported by such a combination.
- Deliverables 5.1 and 5.2 report on the scope, design, execution and outcomes of the evaluation sessions undertaken with successive versions of the enhanced L4A// system.
- Deliverable 6.1 reports on a review of current games applications and related activities being used to support lifelong learners, on the requirements for a game-based application to fit the user groups targeted by the MyPlan project, and on the specification of such an application. Deliverable 6.2 reports on a study of using Second Life for supporting FE/HE learners with their career and education choices, and identifies guidelines for tutors aiming to use Second Life that emerged from this study.

Outcomes

With respect to the project's first aim, we have developed a Lifelong Learner Ontology (LLO) that aims to capture the key attributes relating to lifelong learners, in order to facilitate the exchange of learner data between L4A// services, and in the longer term to facilitate the interoperability of such services with other applications in the lifelong arena. The LLO was defined in RDF/OWL using the Protégé tool (<http://protege.stanford.edu>). We also designed an architecture to support interoperability of learner models across different service-oriented educational systems, which leverages the LLO and other heterogeneous data integration technologies. We developed several usage scenarios in order to validate successive versions of the LLO, one of which requires interoperability between L4A//, the eProfile system (<http://www.essex.ac.uk/chimera/projects/eProfile.html>), and the LearnDirect search service (<http://www.learnirect.co.uk/>).

With respect to the project's second aim, we have developed a method, based on string similarity measures, for identifying the degree of similarity between the timelines of two users. This method underlies the new "people like me" and "what next" functionalities. We have completely redesigned the L4A// system's interface, including the way timelines are displayed and explored graphically – both their own, and their own juxtaposed with another person's. The originally envisioned approach of using expert-defined timelines and/or recommendations for courses has been replaced during the project by an exploration of peer-defined timelines. Deliverable 4.3 reports on the final version of the system. The architecture is service-based and comprises a web portal, and a "back-end" comprising a set of web services implemented as Java servlets. The system is integrated with the LearnDirect API, allowing parametrised search within their repository of courses. It also supports its own MySQL databases containing user information and course information. The software is straightforwardly extensible to provide access to multiple institutional, or other, repositories of course information.

Much positive feedback about the enhanced system was received from students participating in the evaluation sessions. This feedback points to the value of the new personalisation features as perceived by "non-traditional" FE and HE learners. The work with UCAS identified possible mechanisms for interoperability of L4A// with the UCAS web portal, and five new usage scenarios, pointing to the possible broader value of these technologies for more "traditional" learners. In the longer term, we would hope that the collaborations and interactions that took place within the lifetime of the project will serve as a catalyst for the formulation of policies for engaging the interest of lifelong learners and encouraging them to take responsibility for planning and managing their own lifelong learning and continued professional development.

With respect to the project's third aim, a review of current games applications and related activities being used to support lifelong learners was undertaken, the requirements for a game-based application to fit the user groups targeted by the MyPlan project were identified, and a study of using Second Life for supporting FE/HE learners with their career and education choices was undertaken. A list of practical guidelines for tutors aiming to use Second Life emerged from this study. While the benefits of using Second Life in this study were outweighed by the technical issues that arose with the software during the two sessions, some benefits of using Second Life for supporting under-served learners, for engaging learners, and for supported distributed groups of learners were identified. The sessions with the Mentor were viewed as being particularly effective in practice and meriting further exploration.

Conclusions

Lifelong learning is a complex process requiring cross-organisational strategic planning, coordination and collaboration. Lifelong learners form a diverse student population with a variety of backgrounds, evolving needs and varying accessibility requirements. Enabling lifelong learning in practice requires learners becoming more aware of their studying and reflective processes, and the provision of tools and guidance that support their planning of their learning throughout life. Personalised technologies such as those offered by L4A// can assist lifelong learners to formulate and manage their learning

plans under varying circumstances and settings. The use of an ontology-based approach to support personalised planning of lifelong learning, as pioneered by the L4A// system, provides on the one hand a holistic view for the learner of their learning and career trajectories, and on the other hand an integrated view of all aspects of a learner's information that will enable systems to provide more effective support learners in the formulation of their learning and career goals and information needs.

Implications

We believe that our work in the MyPlan project could be built on in a number of ways:

The first concerns the visual representation of learners' timelines. Evaluations of the L4A// system have identified that the current dynamic widget, although very attractive, is not necessarily the most intuitive way of visualising timelines – at least in the early stage of a user's timeline construction. The diversity of tasks revolving round the timeline (e.g. managing your own timeline, searching for similar people, searching for inspirational timelines and episodes, reflecting on others' timelines, etc.), although based on the same information, suggests that a single, general-purpose visualisation may be unachievable and that multiple, complementary or supplementary, dynamically connected representations, should be investigated.

A second point arising is the need to integrate the L4A// system's functionalities within a social platform (or several), in order to supply the social features that are missing from L4A// and in this way to allow users to share more effectively their timeline with peers and to comment on others' timelines. The purpose of this facility would be to encourage reflection, support professional and peer advice in the planning process, draw in more users by "viral distribution", and allow users to draw on each others' personal knowledge.

A third point arising is the potential benefit of enabling interoperability between L4A// and other systems targeted at the lifelong learner. In the previous L4A// project, we reported on users' and technical requirements for the integration of the L4A// system with e-Portfolio tools (see <http://www.lkl.ac.uk/research/l4all/>) e.g. so that users would be able to automatically, or semi-automatically, transfer entries from their e-portfolio in order to create new episodes within their L4A// timeline, or conversely to transfer episode information from their timeline to a CV builder package within an e-Portfolio tool. Popular aspects of e-portfolio systems that would be appealing to L4A// users include reflective blogs, PDP opportunities, and opportunities for tutors and learners to share learning resources. The main gain for users of such an integrated system would be the availability of a broader range of functionality from a single entry point. In the present project, we also reported in Deliverable 4.2 on several new usage scenarios that would be enabled by interoperability between L4A// and the UCAS web site/services e.g. using the UCAS Course Search facility to provide a rich, up-to-date, quality assured source of HE course information to L4A// users; or registering new UCAS applicants with the L4A// system, allowing them to record information about their learning/work experiences to date, and to use the L4A// "what next" functionality in order to obtain inspiration about their own possible future learning and career choices.

Recommendations

Evaluation studies with groups of FE and HE learners show that the L4A// system is easy to understand and use, after a short initial induction session, and in this sense it has the potential to be deployed on a large scale. However, performance benchmarking that we have undertaken of the new capabilities "search for people like me" and "what to do next" indicates that these aspects would need to be further developed (from a technological perspective) in order to be scalable to the volumes of data that would need to be handled were they to be offered as institution-wide or cross-institutional services.

We also recommend that a detailed pedagogical and technical feasibility study is undertaken in order to validate the usage scenarios that we have identified with respect to L4All/ePortfolio and L4All/UCAS interoperability, in the context of users', UCAS's and institutions' requirements and possibly also to identify additional usage scenarios. Business process models would need to be developed, specifying in detail each of these usage scenarios, and their relationship to existing user, institutional and UCAS processes. Following this, evolutions and extensions to the existing software systems would need to be designed and validated by the implementation of demonstrators, in collaboration with selected partner institutions across the lifelong learning arena.

References

All Deliverables of the MyPlan project listed above are accessible from the project website, at <http://www.lkl.ac.uk/research/myplan/>

Also accessible are the presentations by project team members, and others, at the two MyPlan workshops held at the London Knowledge Lab on 3rd May 2007 and 18th November 2008.

The publications arising from the project are as follows:

- De Freitas, S. Rebolledo-Mendez, G., Liarokapis, F., Magoulas, G., Poulovassilis, A. (2009). *Developing an evaluation methodology for immersive learning experiences in a virtual world*. Proceedings 2009 Conference in Games and Virtual Worlds for Serious Applications, IEEE, pp 43-50.
- N. Van Labeke, A. Poulovassilis, G. Magoulas (2008). *Using Similarity Metrics for Matching Lifelong Learners*. Proceedings 9th International Conference on Intelligent Tutoring Systems (ITS'2008), Springer, pp 142-151.
- L.Zamboulis, A.Poulovassilis, J.Wang (2008). *Ontology-Assisted Data Transformation and Integration*. Proceedings 4th International Workshop on Ontology-based Techniques for DataBases in Information Systems and Knowledge Systems, ODBIS 2008, Auckland, New Zealand, August 2008, Co-located with the 34th International Conference on Very Large Data Bases, pp 29-36.
- S. De Freitas, I. Harrison, G. Magoulas, G. Papamarkos, A. Poulovassilis, N. Van Labeke, A. Mee, M. Oliver (2008). *L4All, a Web-Service Based System for Lifelong Learners*. In S. Salerno et al. (Eds), *The Learning Grid Handbook: Concepts, Technologies and Applications*. IOS Press.
- H. Baajour, G.D. Magoulas, A. Poulovassilis (2008). *Towards cross-system user model interoperability for personalised lifelong learning*. Proceedings 6th International Workshop on Ubiquitous User Modeling with focus on User Model Integration (UMI 2008), in conjunction with the 5th International Conference on Adaptive Hypermedia and Adaptive Web-based Systems, July 2008, Hannover, Germany, pp. 28-32.
- Baajour H., Magoulas G. D., and Poulovassilis A. (2007). *Designing services-enabled personalisation for planning of lifelong learning based on individual and group characteristics*, Proceedings of the Workshop on Personalisation in E-Learning Environments at Individual and Group Level, 11th International Conference on User Modeling (UM 2007), Corfu, Greece, 25-29 June 2007.
- Baajour H., Magoulas G. D., and Poulovassilis A. (2007). *Modelling the lifelong learner in a services-based environment*, 2nd International Conference on Internet Technologies and Applications (ITA 07), Wrexham, North East Wales, UK 4-7 September 2007.