Achieving E-learning with IMS Learning Design - Workflow Implications at the Open University of the Netherlands

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ABSTRACT

This paper uses the Open University of the Netherlands as an instructive case for the introduction of e-learning based on the IMS Learning Design specification (IMS LD). The IMS LD specification, as approved by the IMS Global Learning Consortium in 2003, enables the specification and encoding of learning scenarios that describe any design of a teaching-learning process, i.e. support events, exchanges of projects, interactions and communications between participants. In 2004, after several years of small-scale pilots, the Open University of the Netherlands launched IMS LD-based online learning in an operational setting (over 3000 students). Rather than technology, the paper describes the implications for the workflow. The paper explains the processes involved with both IMS LD-based course creation and course delivery. Preliminary findings establish severe inconveniences for developers in the process of course creation, due to immature IMS LD tooling. Tutors, however, comment positively on course delivery, in particular on the way IMS LD supports course logistics, i.e. the arrangement of course runs, the control of student groups, tracking the students' progress and the support to the exchange of messages and papers. Even though the applied IMS LD-models were deliberately kept simple with respect to interactions and methods, students for their part appreciated the online courses, in particular the functionalities typically enabled by IMS LD, like personalised flow, tailored feedback and portfolios. In sum, taking for granted the immature tooling, the IMS LD specification seems to work in large-scale operational settings.

Keywords

Standardisation, Authoring tools and methods, Distance education, Distributed learning environments, Interactive learning environments.

Introduction

Over the last decade, the use of e-learning has expanded enormously. While in the eighties and nineties of the last century computer-assisted learning merely concerned stand-alone applications, the advent of the World Wide Web opened up new possibilities to develop educational computer programs that run across the Internet. Web-based delivery (often referred to as *e*-learning or online learning) has significant advantages over traditional computer-assisted learning, as it enables online tutoring, continuous updating of learning material and the arrangement of computer-supported collaborative work. This would meet contemporary notions of learning, i.e. (social) constructivism and competence learning, which call for complex and realistic learning environments, authentic learning tasks, personalisation and social interactions with peers and tutors (Westera, 2000). In practice, however, web-based instruction often reflects the electronic delivery of "electronic pages": text and images, with only poor interaction (Hedberg, 2001). For this reason students often question the value of web-based delivery and indicate to prefer printed versions (Poelmans, 2002). Personalised program flow and adaptive support, which are well known in canned computer programs, are very rare in web-based instruction. Also, the sensible arrangement and management of collaborative learning and online tutoring are far from straightforward. So far, an important reason for this restrained interpretation of web-based instruction was the absence of technology specifications for distributed learning that would support the logistics of education, i.e. the specification of learning scenarios or program flow, personalisation and interactive sequences between students and tutors and students between themselves. Existing learning technology specifications cover testing, content packaging, sequencing, metadata amongst others (IMS (Instructional Management Systems) Global Learning Consortium, the Advanced Distributed Learning (ADL) Initiative, and the Institute of Electrical and Electronics Engineers, Inc. (IEEE)), that is, they concern the "material" resources for learning (i.e. instructional pages) rather than the essential characteristics of the teaching and learning process.

To enable the design of the dynamics of teaching and learning, the IMS Global Learning Consortium established a new specification for online learning. This specification, named IMS Learning Design (IMS LD), provides a framework of elements that can describe any design of a teaching-learning process in a formal way (IMS LD, 2003). Rather than focussing on "material" learning content, IMS LD enables the design of learning scenarios, which describe a variety of learning events, including learner interactions with teachers, tutors, fellow-students (collaborative learning) and other human or non-human learning resources. It supports pedagogical diversity, personalisation, interoperability and reusability (Koper, 2003; Hermans et al., 2003, see also the website of IMS LD, 2003).

This paper reports the launch of IMS LD-based online courses at the Open University of the Netherlands. Since 2004, some 3000 regular students have enrolled in nine online courses, specified in IMS LD, which are part of the institute's distance education academic degree programmes. So far, the use of IMS-LD courses has been reported before in other contexts like the Universitat Pompeu Fabra (Griffiths et al., 2005), the Alfanet project (http://alfanet.ia.uned.es/) and the Open University of the UK (McAndrew et al., 2004), but these involve only small-scale pilots. To our knowledge this would be the first time that online learning in conformity with the IMS LD specification is applied in an operational setting. Actual coding of the courses occurred in an IMS LD variant: the Educational Modelling Language (EML), which encompasses the IMS-LD specification. In retrospect, EML forms the basis of IMS LD and shares its conceptual starting points with IMS LD (Hummel et al., 2004; see also http://eml.ou.nl/). The choice for EML as initial format was, in fact, pragmatic in kind, as some authoring tools and procedures were available for EML at the time, but not for IMS LD. During the course development process the course files were converted technically into the IMS-LD format. For reasons of convenience we will refer to the term IMS LD rather than EML in the next sections. For the purpose of this paper we will not go into the technical details of IMS LD coding, web player software, file format conversions and content management software, but focus on the processes of course creation and course delivery. These processes differ in many respects from regular course development procedures (Schlusmans et al., 2004).

Although the paper reflects a case study rather than an extensive assessment of a new e-learning technology, we will go into the question whether IMS LD-based learning arrangements can be developed, managed and delivered appropriately.

After a brief explanation of IMS LD and an outline of the educational context of the courses, we will describe the process of IMS LD-based e-learning development and delivery. We will distinguish eight successive stages in the workflow. Also, we will discuss preliminary findings of this new approach and report briefly about the students' and teachers' appreciations of these process-oriented online courses.

Basic Characteristics of IMS Learning Design

Before going into the characteristics of IMS LD, it is important to clarify the concept of learning content, because it may easily give rise to misunderstandings. The term (learning) content is often referred to as knowledge that can be represented in facts, concepts, principles, procedures or theories in a particular domain. Also, content concerns information captured digitally and imparted to learners; formats for e-learning content include text, audio, video, animation, simulation, and more (Learning circuits, 2004). Content becomes tangible, so to speak, as it materialises in books, tapes, files and other physical objects. In addition to learning content, learners should also have access to certain learning tools and services, e.g. calculators, software to edit text, to send e-mail. For learning to occur, learning content and learning tools and services should become part of sensible learning activities, which comprise learner interactions with tutors, fellow-students and other human or non-human learning resources. These learning activities and subsequent support activities are composed in so-called learning scenarios that describe all interactions and transactions that occur or should occur in the learning environment, i.e. support events, exchanges of projects and communications between participants. Thus learning requires the availability of learning content, learning tools and services and learning scenarios. For the whole we introduce the term learning arrangement (see figure 1).

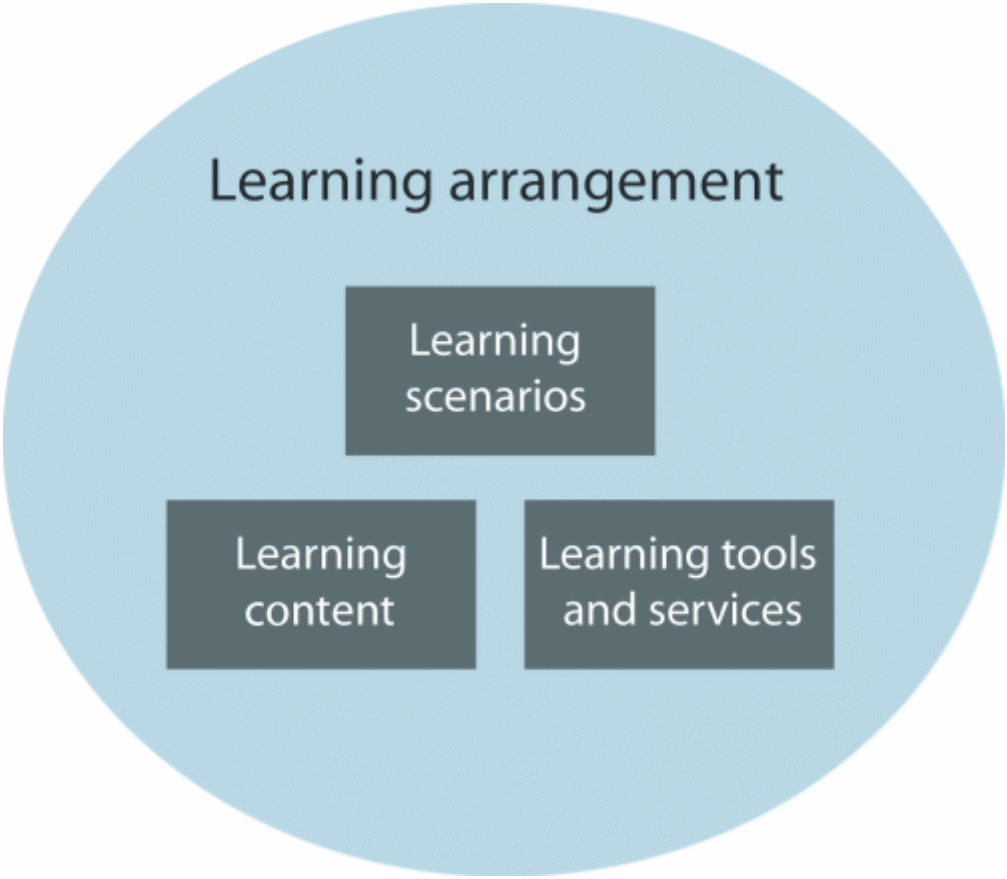

Figure 1. Learning arrangements comprise learning scenarios, content, tools and services

So far, IMS Learning Design is the only specification to cover the whole learning arrangement, because it not only allows the specification of learning scenarios, but it also supports existing technology specifications for learning content and learning tools and services.

IMS LD comprises a pedagogical meta-model that covers a variety of pedagogical concepts. First, the persons involved in the teaching-learning process are supposed to take up one or more specific *roles*, for instance student, reviewer, tutor, examiner, administrator, etc. Secondly, for each role *activities* have to be designed, which lead to certain outcomes. Third, to enable these activities *learning environments* have to be set-up, which offer relevant learning objects, tools and supportive services. Finally, a *method* has to be specified to create an intelligent flow of events in order to allow students to work towards their learning objectives. To a great extent this specification of the process of teaching and learning reflects the notion of a stage play. A play can be divided up into a number of subsequent acts, while each act carries one or more characters or role-parts. In an act each part is linked up with an activity, which describes what that part is supposed to do. Also, the activities make demands on the scenery and props needed (i.e. content, tools, services) to be able to perform the specified activity. In the analogy with a stage play, the roles correspond with the characters, the assigned learning or support activities are the equivalent of the scripted texts and directions for each part, the learning environment is made up of the stage scenery and props and the method offers the overall framework of the complete play. In contrast with a theatrical play, however, activities and methods may be far less prescriptive, as learners and teachers are supposed to be creative and flexible individuals that construct and colour their own realities to arrive at beforehand agreed objectives.

Courses and Their Educational Context

The Open University of the Netherlands provides innovative distance education to some 25.000 students. In accordance with the Open University's paradigm of distance education, students are supposed to study mainly at their homes and are assumed to arrange their own learning with a minimum of staff-support. It offers courses and full degree programmes in Cultural Studies, Business and Public Administration, Environmental Sciences, Psychology, Law and Informatics. Their pedagogical design is based on the notions of competence learning (Barnett, 1994; Westera, 2001). All courses use the Internet as an important information and communication channel, besides the use of other media like DVD, CD-ROM and books. Tutoring and support is provided via the web, the telephone or occasionally in face-to-face meetings in one of the 21 local study centres that are available in the Netherlands and in Belgium.

In 2003, nine courses (study load 120 hours each) have been developed and encoded in IMS LD. The courses are currently being delivered to over 3000 students. All courses are part of the academic bachelor programmes of the Open University of the Netherlands in the areas of Business Administration, Psychology and Law, respectively. In accordance with the notion of distance education these online courses are highly self-contained and offer built-in facilities for support and feedback. The lack of face-to-face interactions is partly compensated for by incorporating various modes of virtual interaction between students and between students and tutors. IMS-LD offers the possibility to model these interactions. In our courses, for example, we have modelled the workflow that is associated with providing feedback on completed learning tasks and delivered work. Such model accounts for a sequence of necessary messages that have to be exchanged between a student and a tutor in order to complete the course: at a certain stage student X has to send an assignment concerning task Y, or, before a certain date tutor Z has to comment on the assignment submitted for task Y, etcetera. For every user, the necessary actions for a particular role are displayed as a tailored activity listing. In some of the courses we modelled a portfolio to collect all subsequent products and comments. The submission of work and feedback can be accompanied by “notifications” that inform the receiver that some necessary action has occurred. Furthermore IMS-LD offers built-in functionality to “track-and-trace” students and teachers on various activities, for instance activity completion. All these data are stored within the delivery system. All communication, notification and exchange of documents (i.e. papers, projects) between students and tutors are handled by IMS LD scenarios (cf. the method concept).

Note that such an integrated and interactive approach excels common e-learning practices, which focus on providing (additional) course information via a “learning management system”: teachers putting their lecture notes on the web. Integration of e-learning requires a complete rethinking of the educational processes (Schlusmans et al., 2004).

The Development of IMS LD-Based E-Learning

To describe the development of IMS LD-based learning arrangements the associated e-learning process will be divided up into 8 stages, each of which will be briefly explained (see figure 2).

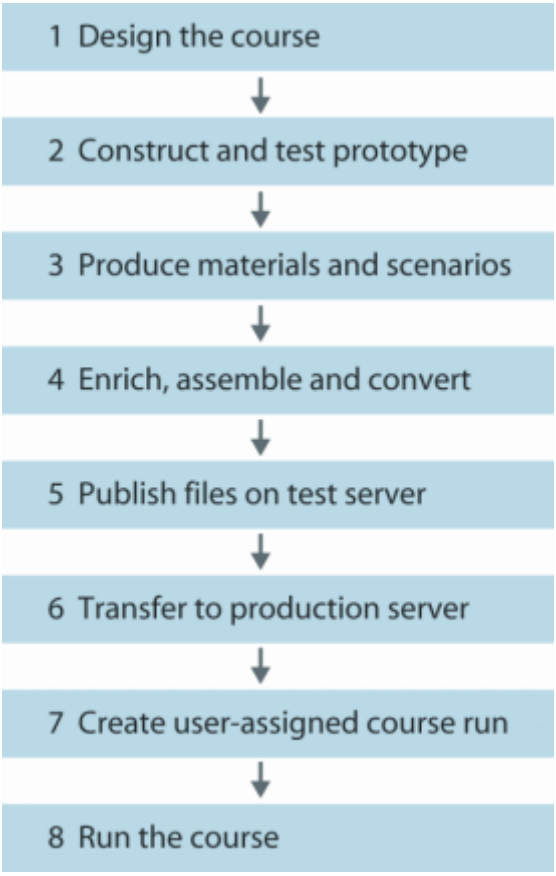

Figure 2. Steps in creating IMS LD-based learning arrangements

The steps depicted in figure 2 may seem not to be extraordinary and could be applied in any course development. However, when these steps are combined with IMS LD, innovative new methods of course development arise, because IMS LD urges to focus on scenarios, logistics and interaction rather than content as such. It thus covers the design of the whole learning arrangement (Sloep et al., 2005). Naturally, in this process much iteration between stages may occur. Below, we will briefly explain the subsequent steps.

Design the course

As a first step an instructional course design has to be made, which naturally is based on the analysis of target groups, content characteristics, learning objects, pedagogical starting points, various boundary conditions, etc. In this respect it doesn't differ from any other course design process. The difference, however, lies in the fact that the design has to conform to the formalised concepts of IMS LD and should cover the description of roles performed by students and staff, learning activities, support activities, content, tools, interactions, etc. (Janssen & Hermans, 2005). Ideally, this is accomplished implicitly by applying a user-friendly design tool or authoring tool, but due to the lack of tools so far, the mapping has to be done by IMS LD experts. The design is made explicit through a textual description or a graphical representation (i.e. UML: Unified Modelling Language) in order to facilitate communication, discussion and fine-tuning to reach agreement on the design. This approach is especially useful when educational technologists and subject experts work together in a course team, but it is of even greater importance for the robustness of an IMS LD course design, in order to avoid the need to make adjustments at a later stage. Certainly in the case of more complex designs, adjustments are error prone and time consuming.

Construct and test an IMS LD course prototype

The instructional model has to be implemented in an IMS LD template that represents the full structure of the envisioned course. The template serves as an operational prototype, which, at will, may even contain some

exemplary content. The encoding of educational arrangements in the IMS LD format requires detailed specification of roles, activities, environments and methods (see figure 3).

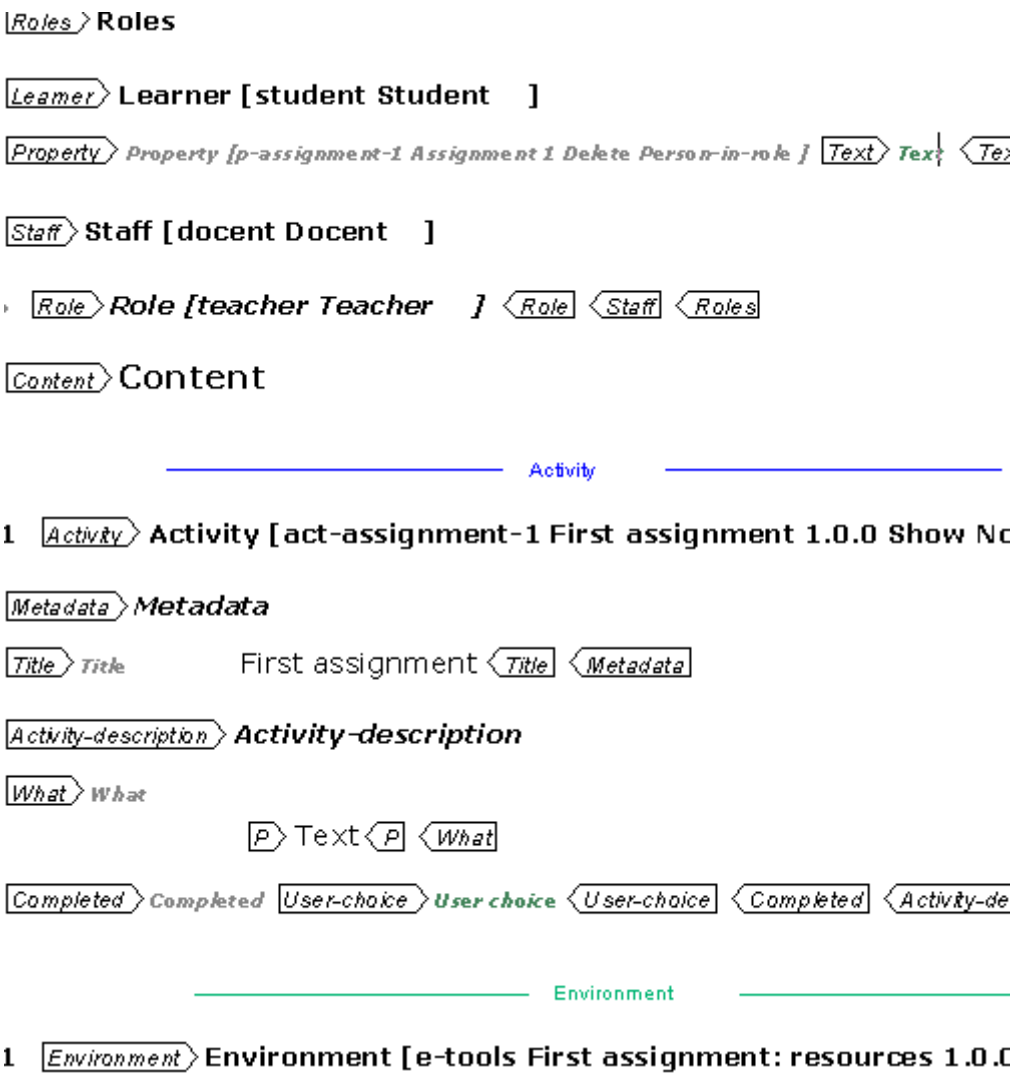

Figure 3. A specimen of a tagged course sequence

At this stage, instructional designers, IMS LD modellers and domain specialists work closely together, while maintaining a clear role division to realise efficient course creation. In order to test the prototype an IMS LD test environment is available, which is capable of interpreting and displaying IMS LD. We chose to deliver through the web and therefore we have developed IMS LD web player software, which makes IMS LD-based e-learning available through a web-browser. Today, various new initiatives for IMS LD web player software are coming up, for instance the IMS LD engine Coppercore (http://coppercore.org/) and the Learning Activity Management System (LAMS, 2004).

By publishing the IMS LD prototype through this web player software, the course team can experience the integral course scenario, check the consistency of its design and adapt it when desired. Constructing and publishing such a course prototype proves helpful to facilitate the discussions amongst the course team members to arrive at a proper course design.

Produce materials and scenarios

WYSIWYG ("What You See Is What You Get") authoring environments for IMS LD are not yet available. Therefore, second best solutions have to be used for the authoring of learning content. To shield authors from

detailed tagging and encoding (see figure 3) we provided them with simple and tailor-made content-definition forms (MS Word), which - after completion by authors - could be easily converted to the required file format. Such forms have been made available for the more or less standardised pieces of textual content (interaction types, cases, references, multiple-choice questions, etc.). This procedure leads to a collection of encoded course components. During the process of course creation, standard file-management software was installed to allow users to (remotely) store, search and access the various components and keep track of versions.

Enrich, assemble and convert

During this stage, the encoded course components are processed further: pictures are added, occasionally layout and identifiers are added, while various integrity checks are carried out as well. The intermediate result of this stage in the authoring process is a number of well-designed, enriched and labelled IMS LD files to be stored in a database of course components. Next, the course components have to be assembled according to the integral course prototype (cf. stage 2). The resulting composed file is then converted to meet the full IMS LD specification. At this stage the resulting file is ready to be published and tested.

Publish files on test server

As a next step the complete set of IMS LD files is published on a test server. This is a one-off pre-processing of the learning design to perform validation of the course materials and to ease processing during delivery. In the test environment the courses are checked for validity of the encoded scenarios, for presence and accessibility of all required functions, services, learning objects, etc. and for correct functioning of interactions and the modelled method. Any errors are returned to the relevant specialists involved, to be corrected in a new course version. Publication of a course, whether in a test environment or in a production environment, involves also the linking of a style sheet to the course. This enables the adjustment of the look and feel of the web player to meet style and user requirements.

Transfer to the production server

Once the authors are satisfied with the test, the course files can be transferred to the production environment, which is technically identical to the test environment, be it that the performance of the production environment meets higher standards in order to serve many concurrent users. The production environment is meant to deliver the courses to learners and staff, like tutors, coaches, examiners etc. At this stage all learners are enrolled for a publication, so that they can be assigned to different course runs.

Create user-assigned course runs

The production system is responsible for the execution and processing of the instantiated learning design. The IMS LD-based courses can be instantiated as often as needed, each time for different people, different groups, at different dates and locations. The term ‘run’ is introduced to handle this. A run is defined as a logical grouping of people, or an instantiation of a course to enable multiple delivery of the course without having to duplicate structure or contents (Tattersall et al., 2005). Only users that have been enrolled can be assigned to a run. Here, course management is required to enable multiple deliveries of a course to different users or user groups. To achieve this, a course management tool has been developed. This tool constitutes the administration layer, providing a single point of access for all administrative functionality. It enables the publication of a course instance, the enrolment of learners and the assignment of users to a specific run and to their intended role in the course. It also covers logging and portfolio management, management of style packages, updating of content, the management of runs and the management of defined roles. In practice, it wouldn’t be a problem to assign various roles to one person, as often is the case for teachers. Within the Open University of the Netherlands, however, the division of labour is strongly implemented, as is the case for other distance education universities. This is in accordance with the idea that these different roles require different competencies.

Run the course

When students and tutors are assigned to a certain run (and informed about it) the course is made available to users by running the IMS LD web player on a server. The web player software takes care of the personalised delivery of the IMS LD-encoded courses to the end user through the World Wide Web. At the client side

(students, tutors, etc.) a standard web browser (MS Internet Explorer version 5.5 or higher) is sufficient to display all e-learning objects and interactions.

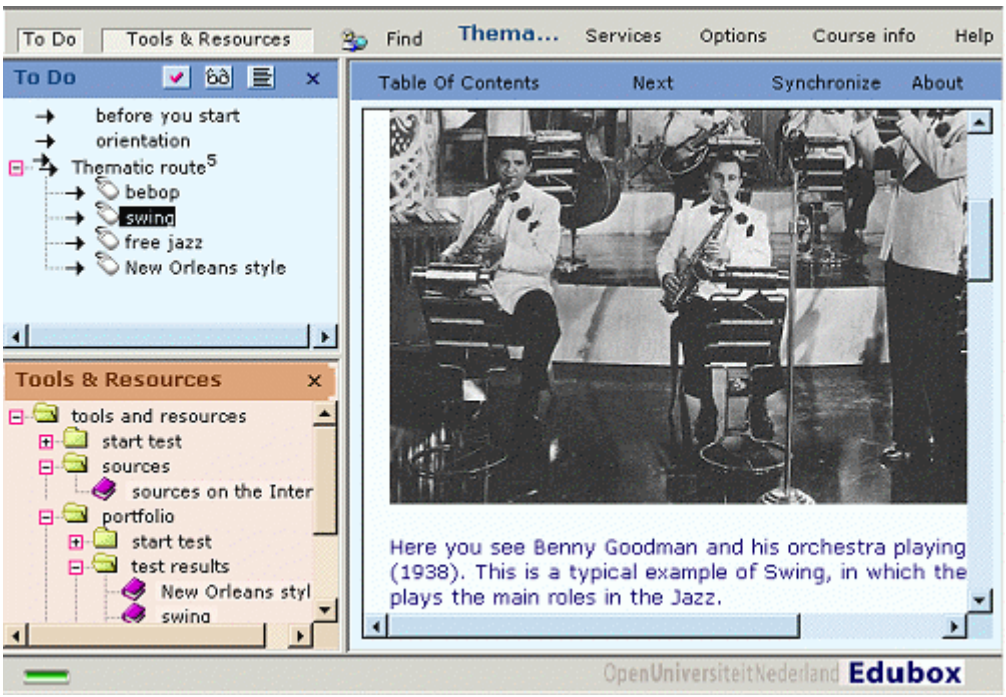

Figure 4. Student's view of an IMS LD-based course in a standard browser window

In figure 4 a tailored style sheet has been applied. The top-left of the picture displays the activity pane listing the student's learning tasks (To Do list). Note that this pane corresponds with the activity concept in IMS LD. The bottom-left pane makes available the tools and the content that are needed to carry out the selected learning task. In fact, it presents the specific learning environment as defined in the environment concept of IMS LD. The main pane on the right (only partly visible here) displays the actual activity to be carried out by the student or the tutor, i.e. the description of the activity selected from the activity pane (To Do list). This pane can be maximised at will by the students. What cannot be displayed in figure 4 is that the web player not only presents various pieces of learning "content" in the browser, but also handles interactive learning scenarios as encoded in IMS LD, i.e. conditioned flow, notifications, exchange of papers and group work. For this purpose, the web player software has been integrated technically and functionally with the Open University's web-portal "Study web" (Westera, 2003), which provides access to synchronous as well as a-synchronous communication and conferencing facilities. Furthermore, it should be noted that the web player's look and feel as shown in figure 4 is only illustrative, because the style sheet can be changed at will to meet corporate requirements.

Preliminary Findings

So far, some preliminary findings are worthwhile reporting. We briefly go into two questions. First, is it possible at all to develop, manage and deliver IMS LD-based learning arrangements appropriately on a large scale (thousands of users)? Secondly, what are the students' appreciations of these process-oriented online courses?

With respect to the first question, it is clear to all staff involved that the process of IMS LD course creation is still quite laborious. The absence of an appropriate authoring environment impelled the course teams to an inconvenient set of provisional tools, templates and conversion steps. The process is controllable, but also complex and time-consuming. Previewing a constructed piece of education takes some processing steps, which causes delayed feedback to course developers and domain specialists involved. So far, course developers and authors are quite unhappy because of this immature tooling. A conclusion, which was also reached in the Universitat Pompeu Fabra case studies (Griffiths et al., 2005). Various initiatives should be mentioned, however, that aim to specify and develop IMS LD-based editors for future use, for instance the RELOAD-project (Reusable E-Learning Object Authoring and Delivery, http://www.reload.ac.uk). An overview of the current state of development of Learning Design tools is available at the site of the UNFOLD-project (Understanding

New Frameworks Of Learning Design, http://www.unfold-project.net:8085/UNFOLD/general_resources_folder/tools/currenttools).

With respect to course delivery and course management, staff comments are quite promising. Tutors for their part commended the course management procedures to arrange course runs, to control student groups, to track the students' progress and to support the exchange of messages and papers. Delivery as such seems to be quite straightforward within the context of the Open University of the Netherlands. The web player software could easily be integrated within the existing "Study web"-environment, which enabled a flying start.

As for the second question, the students' appreciations, first findings are encouraging, be it not conclusive so far. A running survey amongst 180 students (response 71 students) shows positive appreciations by the majority of students. Despite occasional problems with start-up or with performance (some 30% of the students still use analogue telephone lines to connect to the Internet) students value the way the courses are arranged and the way they guide them through the various learning activities. In particular, the functionalities typically enabled by IMS LD, like personalised flow, tailored feedback and portfolios were appreciated. IMS LD thus provides a valuable extension of the virtual learning environment of our institution: it marks a shift from "a predominantly supporting function of the virtual learning environment, with a strong focus on information service, towards regulation of the primary educational process for both students and staff" (Janssen & Hermans, 2005).

We repeat once again that this paper reflects a case study rather than an extensive evaluation of new e-learning technologies. It should be noted that some methodological problems would arise when we would try to draw general conclusions from our case. With respect to the first question (is it possible at all?): the applied IMS LD-models were deliberately kept simple with respect to interactions and methods. Therefore, only a small part of the wide possibilities of IMS LD have been explored. Gradually, extended functionalities will be applied in future courses. With respect to the second question (what about students' appreciations?): the sophistication of this e-learning approach greatly concerns the institute's back-office: the process of encoding, course instantiation and course management. These remain largely concealed at the end user level: students may hardly notice the sophisticated server-side technologies. In the end, students' appreciations and performances essentially will depend on the quality of the instructional approach.

Conclusion

In sum, our case shows the first steps of large-scale implementation of IMS LD-based e-learning. Promises are high, even though the transition from neat learning technology specifications (IMS LD) towards the full arrangement of IMS LD-based online learning is not straightforward. We stressed that the steps in figure 2 when applied with IMS LD, lead to new ways of e-learning development. Through its focus on scenarios, logistics and interaction rather than content per se, IMS LD has an impelling influence on e-learning developers to treat all relevant issues of the educational design from an integral perspective: roles, activities, flow, methods, environments, etc. To a certain extent this may be unpleasant or laborious, not only because of immature technical tooling. It is the price to be paid for making design decisions explicit.

While our efforts focused mainly on getting IMS LD technologies implemented in an operational setting, further research would be necessary to investigate these promises, in particular the assessment of efficient course modelling, practical reuse of learning content, personalisation and, of course, effective and attractive learning. Naturally, large efforts on technical tooling are pressing. The research agenda should also cover ways to link instructional design methods to the specification of learning scenarios, arrangements and learner interactions. Also, new empirical data in various contexts are necessary to assess IMS LD's usability for educational practice.

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