ISURE: Usage of IMS-LD for Communication and Collaboration Services

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Executive Summary

The IMS Learning Design (IMS-LD) Specification offers a language for describing complex, multi-role oriented learning arrangements. IMS-LD places learning and teaching activities in the center of attention and thus goes beyond the mere description of learning material. However, IMS-LD offers just a small set of pre-specified services for collaboration and communication between participants of an IMS-LD Learning Opportunity. Thus, the question arises in how far the technical restrictions of IMS-LD’s service-definition have to be modified to include a wider range of collaboration and communication services while still maintaining the interoperability of the corresponding IMS-LD Learning Designs/Opportunities that was set out as one of the goals of standardization. Hence, the main objective of this ISURE (ICOPER Suitability Report for Better Practice) is to reveal whether and to which extent (new and changing) collaboration and communication services can be still integrated in standardised Learning Designs/Opportunities in order to benefit from reusability and interoperability even if there are only a few pre-specified services within the IMS-LD Specification available. However, instead of arbitrarily integrating collaboration and communication services into IMS-LD, the primary focus of this ISURE lies on:

1) The selection and application of best practice collaboration and communication services (here: combinatorial tool, forum, [micro-]blog, shared desktop environment as a kind of combinatorial tool, and wiki) in IMS-LD Learning Designs/Opportunities

2) An investigation of the ability of a) the IMS-LD Specification as well as b) corresponding IMS-LD editors and players to support such collaboration- and communication-intense Learning Designs/Opportunities considering particular requirements relevant to learning facilitators.

Based on this approach, the following best practice collaboration and communication services are carved out: Combinatorial tool, forum, [micro-]blog, shared desktop environment as a kind of combinatorial tool, and wiki.

Furthermore, a comprehensive set of recommendations towards the following stakeholder groups is derived which serves as a first starting point for further elaborations on potential application profiles, respectively standard elements and tool developments to better integrate collaboration and communication services into the IMS-LD Specification as well as its corresponding tools:

1) Course designers/learning facilitators experienced in TEL in general, and IMS-LD in particular (see Chapter 3.2: Recommending best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players)

2) Standardisation bodies (see Chapter 3.4: Recommending missing/new standard elements for potential application profiles of IMS-LD collaboration and communication services to realize a successful application of best practice

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1 For further details please have a look at Chapter 3.1: Learning facilitators’ requirements were derived during a WP5 workshop at the ICOPER General Assembly, 18th of May, 2010, Crete, where 10 ICOPER partners, all of them experienced in course design, learning facilitation and the IMS-LD Specification, respectively its corresponding tools, participated in.

2 In the realm of this ISURE, combinatorial tools are defined as collaboration/communication services which combine major characteristics, respectively features of particular collaboration/communication services (e.g. audio/video conference, forum, wiki, etc.), and thus provide learners and learning facilitators with a huge plethora of collaboration/communication functionalities in one single user interface.
collaboration and communication services considering learning facilitators’ requirements)

3) **IMS-LD technology providers** (see Chapter 3.4: Recommending how to modify IMS-LD editors and players to support these best practice collaboration and communication services)

In particular, **we recommend**, amongst others, that there is a need to support a) communication, respectively synchronisation between (different) IMS-LD Learning Opportunities deployed in different runtime environments (RTE), b) a better integration of external tools or services into IMS-LD Learning Designs/Opportunities, c) the definition of “emerging roles” as well as the conception and design of more user-friendly IMS-LD editors and players.

With a view to the **ICOPER Reference Model (IRM)**, this ISURE is thus concerned with the following types of **Shareable Educational Resources** (SER): Learner, Learning Content, Learning Design, Learning Facilitator, Learning Method, Learning Opportunity, and Learning Tool. Thereby, this ISURE primarily contributes to the **IRM data and guidance level**. This is due to the fact that the recommendations for potential application profiles of IMS-LD collaboration/communication services to be derived in Chapter 3 primarily contribute to the **IRM data level**. Beyond, as Chapter 3 also recommends best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players, this ISURE contributes to the **IRM guidance level** as well.
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List of Abbreviations

CCSI  CopperCore Service Integration
DKT   Dangerous Knowledge Tour
GSI   Generic Service Integration
IMS-CC IMS Common Cartridge
IMS-CP IMS Content Packaging
IMS-LD IMS Learning Design
IMS-QTI IMS Question and Test Interoperability Specification
IRM   ICOPER Reference Model
ISURE ICOPER Suitability Report for Better Practice
LAMS  Learning Activity Management System
LMS   Learning Management System
OGLM  Open Graphical Learning Modeller
OICS  Open ICOPER Content Space
PALO  Personal Achieved Learning Outcome(s)
RTE   Runtime Environment
SCORM Sharable Content Object Reference Model
SER   Sharable Educational Resource
SSO   Single-Sign-On
TEL   Technology Enhanced Learning
VLE   Virtual Learning Environment
1 Introduction

Standardisation efforts have been undertaken for Technology Enhanced Learning (TEL) with the goal to make learning materials and even complex Learning Designs/Opportunities reusable, interoperable, and exchangeable between persons, institutions, and systems. Thereby, the IMS Learning Design (IMS-LD) Specification offers a language for describing complex, multi-role oriented learning arrangements. IMS-LD places learning and teaching activities in the center of attention and thus goes beyond the mere description of learning material. To this day IMS-LD is the only Specification that offers ample means to express complex learning arrangements as just little limitations to the expressiveness have been shown. IMS-LD is thus predestined to serve as a representative standard for TEL especially in relation to Web 2.0 collaboration and communication services as well as such collaboration and communication services inherent to current Learning Management Systems (LMS)/Virtual Learning Environments (VLE), respectively corresponding IMS-LD players that enable the execution of IMS-LD Learning Opportunities [33]. However, IMS-LD offers just a small set of pre-specified services for collaboration and communication between participants of an IMS-LD Learning Opportunity. Thus, the question arises in how far the technical restrictions of IMS-LD’s service-definition have to be modified to include a wider range of collaboration and communication services while still maintaining the interoperability of the corresponding IMS-LD Learning Designs [14, 33]/Opportunities that was set out as one of the goals of standardisation.

Hence, the main objective of this ISURE (ICOPER Suitability Report for Better Practice) is to reveal whether and to which extent (new and changing) collaboration and communication services can be still integrated in standardised Learning Designs/Opportunities in order to benefit from reusability and interoperability even if there are only a few pre-specified services within the IMS-LD Specification available [23].

However, in order to better fulfill the report’s formal requirements (ICOPER Suitability Report for Better Practice), this ISURE does only focus on the investigation of such collaboration and communication services which are perceived, respectively (already) turned out to support course designers (here: Person who designs IMS-LD Learning Designs that are instantiated to IMS-LD Learning Opportunities) and learning facilitators (here: Person who supervises learners in corresponding Learning Opportunities [33]) in their current practice. This is, instead of arbitrarily integrating services into IMS-LD, the primary focus of this ISURE lies on a) the selection and application of best practice collaboration and communication services in IMS-LD Learning Designs/Opportunities as well as b) an investigation of the ability of the IMS-LD Specification as well as corresponding IMS-LD editors and players to support such collaboration- and communication-intense Learning Designs/Opportunities considering particular requirements relevant to learning facilitators’ requirements’.

Based on this, a comprehensive set of recommendations towards the following stakeholder groups is derived which serves as a first starting point for further elaborations on potential application profiles, respectively standard elements and tool developments to better integrate collaboration and communication services into the IMS-LD Specification as well as its corresponding tools:

1) Course designers/learning facilitators experienced in TEL in general, and IMS-LD in particular (see Chapter 3.2: Recommending best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players)
2) **Standardisation bodies** (see Chapter 3.4: Recommending missing/new standard elements for potential application profiles of IMS-LD collaboration and communication services to realise a successful application of best practice collaboration and communication services considering learning facilitators’ requirements)

3) **IMS-LD technology providers** (see Chapter 3.4: Recommending how to modify IMS-LD editors and players to support these best practice collaboration and communication services)

Thereby, in the realm of this ISURE best practice is defined as course designers’/learning facilitators’ and learners’ successfully proven application of a) particular communication and collaboration services (synonym: learning tools [33]) to facilitate communication and collaboration intense IMS-LD Learning Designs and Opportunities by use of b) particular IMS-LD editor(s) and player(s). Thus, in the realm of this ISURE, the term best practice is threefold, namely best practice with a view to the:

- Selection and application of particular collaboration and communication services (i.e. tool-oriented)
- Selection and application of particular IMS-LD editors and players (i.e. tool-oriented)
- Way to use these collaboration and/or communication services in IMS-LD editors and players (i.e. process-oriented)

With a particular view to the **ICOPER Reference Model** (IRM), this ISURE is thus concerned with the following types of **Shareable Educational Resources** (SER) [see Figure 1, based on 33, p. 25]:

![Diagram](image_url)

**Fig. 1.** D5.3 Main Concepts Related to the IRM: Overview

Thereby, this ISURE primarily contributes to the **IRM data** and **guidance level** [33]. This is due to the fact that the recommendations for **potential application profiles** of IMS-LD

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1 For further details please have a look at Chapter 3.1: Learning facilitators’ requirements were derived during a WP5 workshop at the ICOPER General Assembly, 18th of May, 2010, Crete, where 10 ICOPER partners, all of them experienced in course design, learning facilitation and the IMS-LD Specification, respectively its corresponding tools, participated in.
collaboration/communication services to be derived in Chapter 3 primarily contribute to the IRM data level. Beyond, as Chapter 3 also recommends best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players, this ISURE contributes to the IRM guidance level as well [33].

To better accomplish these goals, the ISURE is structured as follows: Chapter 2 provides a brief overview about (best practice) collaboration services (see Chapter 2.1) which is completed by a brief introduction into IMS-LD (see Chapter 2.2.1) as well as a state of research about IMS-LD collaboration and communication services in particular (see Chapter 2.2.2). Chapter 2 concludes with a prototypical example of communication facilities inherent to the IMS-LD Specification (see Chapter 2.2.3).

Chapter 3 deals with evaluating the usage of IMS-LD for communication and collaboration services. Thereby, the primary focus of this chapter lies on the derivation of recommendations targeting a) course designers/learning facilitators (see Chapter 3.2: Recommending best practice collaboration and communication services and their actual usage in best practice IMS-LD editors and players), b) standardisation bodies (see Chapter 3.4: Recommending missing/new standard elements for potential application profiles of IMS-LD collaboration and communication services) and c) IMS-LD technology providers (see Chapter 3.4: How to modify IMS-LD editors and players to support these best practice collaboration and communication services) which altogether serve as a first starting point for further elaborations on potential application profiles, respectively standard elements and tool developments to better integrate collaboration and communication services into the IMS-LD Specification as well as its corresponding tools.

Based on the outcomes of Chapter 3, overall conclusions as well as implications for future research are drawn (see Chapter 4).
2 Collaboration and Communication Services

2.1 General Overview

According to the IRM, Communication and collaboration services (synonym: learning tool) are defined as “deployed technologies that are used in, and in this way facilitate the support of, a Learning Opportunity. Examples of learning tools are a blog, chat, forum, wiki, etc.” [21, p. 11; 33, p. 24]

Communication and collaboration services can be roughly categorized into two main categories, namely synchronous and asynchronous services [17, 18]. Each category in turn encompasses a plethora of potential sub-categories, amongst them for [39]:

1) Synchronous communication and collaboration services:
   - Audio/video conferencing
   - Chat: Manages one on one messaging as well as multiple users
   - File transfer and application sharing
   - Whiteboard: Shared editing and idea sharing

2) Asynchronous collaboration services:
   - Blog: Use of asynchronous messaging in reverse chronological order about a particular topic
   - E-mail: Asynchronous collaborative messaging
   - Forum: Asynchronous collaborative messaging
   - Microblog: A blogging variant that limits the length of messages
   - Social bookmark: Helps users share, classify and discover Web resources [42].
   - Social network: Allows individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system [1].

According to [26], communication is understood as “the imparting or exchanging of information by speaking, writing, or using some other medium”, whereas collaboration is defined as “the action of working with someone to produce something”. Thus, in the realm of this ISURE, the term collaboration/communication is understood as the synchronous and/or asynchronous exchange and/or mutual creation of (non-)textual information relevant to a particular Learning Design/Opportunity (e.g. oral presentation, mutual preparation of a term paper/project work, etc.). This process in turn requires a vast repertoire of Learning Outcomes in interpersonal processing, listening, observing, speaking, questioning, analysing, gestures and evaluating which is established by use of collaboration-/communication-intense Learning Designs/Opportunities (see Chapter 3.2.41).

Regarding best practice collaboration and communication services to be supported by an IMS-LD editor and player, learning facilitators [22] considered the following services to

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1 For further information about Learning Outcomes, respectively Personal Achieved Learning Outcome Profiles please have a look at: WP2, D2.3.
Successfully support them in delivering (IMS-LD compliant) Learning Opportunities due to their particular characteristics, respectively features:

- **Combinatorial tool**:  
  - Storage processing  
  - Work spaces for  
    - Private purposes  
    - Group work  
  - Desktop/File sharing support  
  - One2one communication  
  - One2many communication (broadcasting)  
  - Group communication  
  - Synchronous (e.g. audio/video conferencing, chat)  
    - Enables face2face communication  
    - Facilitates socialising, i.e. prevents solitariness of learners  
    - Facilitates oral expressiveness

- **Forum**:  
  - Scalable  
  - Structured information (requires guidance and organisation from the learning facilitator)

- **(Micro-)Blog**  
  - Well-suited for individual learning and/or learning in small groups  
  - Facilitated the accumulation of learning artifacts (“diary”, ”portfolio”)  
  - Facilitates the management of a huge amount of information  
  - Facilitates the reflection of the ongoing/completed learning process

- **Wiki**  
  - Collaborative learning  
  - Re-arranging and building knowledge

Hence, even though there is a vast variety of collaboration/communication services, this ISURE only focuses on such collaboration/communication services that turned out to support learning facilitators in delivering (IMS-LD compliant) Learning Opportunities successfully (see Chapter 3).

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1 In the realm of this ISURE, combinatorial tools are defined as collaboration/communication services which combine major characteristics, respectively features of particular collaboration/communication services (e.g. audio/video conference, forum, wiki, etc.), and thus provide learners and learning facilitators with a huge plethora of collaboration/communication functionalities in one single user interface.
2.2 Collaboration and Communication Services in IMS-LD

The subsequent elaboration provides a short introduction to IMS-LD (see Chapter 2.2.1), presents a state of research of collaboration and communication services in IMS-LD (see Chapter 2.2.2) which is completed by a prototypical example of communication facilities inherent to the IMS-LD Specification (see Chapter 2.2.3).

With a view to the IRM, the IMS-LD Specification is positioned at the IRM data level [33]. Hence, the recommendations for potential application profiles of IMS-LD collaboration/communication services to be derived in Chapter 3 primarily contribute to this IRM level. Beyond, as Chapter 3 also recommends best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players, the IMS-LD Specification is positioned at the IRM guidance level as well [33].

2.2.1 Introduction to IMS-LD

The main objective of the IMS-LD Specification is the provision of a containment framework of elements that can describe any design of a teaching-learning process in a formal way [15]. Thereby, the originally intended objectives of IMS-LD are [20, pp. 6-7]:

- The standardised description of an adaptive learning and teaching process which takes place in a computer-managed course, i.e. these courses:
  - are “developed” before they are used
  - can be used by different groups/classes of learners at different times (principle: “Develop once, run many times”)
  - are managed by the computer (here: Runtime), not by the teacher
  - are designed to achieve some Learning Outcomes\(^1\) for a given target group (prerequisites) as effective and efficient as possible for the individual learner
- The support of all types of learning designs based on various pedagogical approaches
- To have the learning and support activities at the centre, not the content
- To provide an integrative framework for a large number of learning content\(^2\) [33] such as IMS Common Cartridge (IMS-CC) [10], IMS Content Packaging (IMS-CP) [11], IMS Question and Test Interoperability Specification (IMS-QTI) [16]\(^3\), Sharable Content Object Reference Model (SCORM) 2004 [1] as well as collaboration/communications services (e.g. audio/video conference, forum, and virtual classroom)

The IMS-LD Specification is thus considered to be an answer to the shortcomings of the existing learning technology Specifications, focusing mainly on the sequencing of learning

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\(^1\) For further information about Learning Outcomes and Personal Achieved Learning Outcome Profiles please have a look at: WP2, D2.3.


objects. This is due to the fact that IMS-LD links activities to environments (consisting of learning content and tools) and roles (e.g. learner, learning facilitator), all of them managed by a teaching method\(^1\), respectively instructional model. Thereby, the teaching method is implemented into a so-called IMS-LD Learning Design. The IMS-LD Learning Design thus can be understood as a contextualized, self-contained unit of education or training such as a course, a module, a lesson, etc., which uses (collaboration/communication) services/tools, learning content as well as teaching methods, and which is designed by corresponding IMS-LD editors. As soon as the IMS-LD Learning Design is implemented, respectively rendered by so-called IMS-LD players/runtime environments [24], it is called an IMS-LD Learning Opportunity in the realm of this project [33, see Figure 1 and Figure 2].

In this sense, the IMS-LD Specification expresses a standardised modeling language for representing Learning Designs as a description of teaching and learning processes able to be executed by a software system, being an IMS-LD editor and/or player. The software in turn coordinates all involved roles (e.g. learner, learning facilitator), the provision of learning content as well as corresponding (collaboration/communication) services/tools [9, 33].

With respect to learning delivery modes, IMS-LD supports mixed mode delivery (blended learning) enabling traditional approaches such as face-to-face teaching, the use of books and journals, lab work, and field trips to be also specified as learning activities and combined with computer-supported learning [14].

Hence, IMS-LD shows the following characteristics which may support educators in their teaching activities [29]:

- Support of pure present, pure distance, and/or blended learning delivery modes
- Description of teaching methods as multi-actor workflow processes, instead of single actor activity tree, i.e. enabling
  - activity-based learning
  - role-based learning
- Integration of the description of collaboration/communication services (e.g. audio/video conference, forum, and virtual classroom)\(^2\)
- Implementation of a variety of teaching methods
- Integration of a variety of learning content formats (e.g. IMS-CC, IMS-CP, IMS-QTI, SCORM 2004)
- Reusability of (particular aspects of) IMS-LD Learning Designs/Opportunities

Thus, the overall scope of the IMS-LD Specification is the description of a formal way to represent the structure of an IMS-LD Learning Design/Opportunity and the concept of a pedagogical method (teaching method) by developing a framework to support pedagogical diversity and innovation while promoting the exchange and interoperability of SER [13, 14, 33].

Figure 2 summarises the main concepts of the IMS-LD Specification and their relationships amongst each other in order to establish a common basis for the subsequent elaborations [14]:

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\(^1\) For further information about Teaching Methods in particular, respectively IMS-LD at design time in general please have a look at: WP3, D3.2.

\(^2\) For further reading about IMS-LD collaboration/communication services see Chapter 2.2.2.
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Fig. 2. IMS-LD Main Concepts: Overview
Having the core structural IMS-LD elements in mind, it is important to know that the IMS-LD Specification has put forth three levels of implementation and compliance, namely level A, B, and C, in order to enable phasing the software implementation efforts (see Figure 2).

Each of these levels provides an increasingly higher amount of detail and complexity for designing teaching and learning scenarios [9, 13, 14]:

- **Level A** provides all basic elements for linearly sequencing activities and linking learning objects as well as services to them.

- **Level B** adds to Level A properties and conditions for user modelling, assistance and personalisation. While Level A is mainly considered with the sequencing of activities, Level B allows the structuring of individualised learning paths using generic properties to store data and conditions to act upon them. This means that learning objects and activities in an IMS-LD Learning Design/Opportunity can be adapted during runtime based on personal preferences or situational circumstances like assessment scores\(^1\) of learners.

- **Level C** adds notification or "messaging" both between system components and between roles (here: learners and learning facilitators). This adds a new dimension by supporting real-time event-driven work/learning flow. Then, activities can be set as a consequence of dynamic changes to the learner's profiles and/or of events generated in the course of the learning activities. It can also be used to trigger messages being dynamically sent to participants. More generally, it enables the automation of learning flow activities, which are triggered by the completion of tasks, rather than the learning flows being pre-planned. Additionally, Level C also allows role-/game-/play and event-driven simulations [13].

The approach taken in the IMS-LD Specification is therefore not to define a single large schema with a core of mandatory elements and numerous optional elements, but rather to define a complete core that is yet as simple as possible, and then to define two levels of extension that capture more sophisticated features and behaviours [14].

### 2.2.2 Collaboration and Communication Services in IMS-LD: State of Research

In the IMS-LD information model [14], activities take place in environments, which can contain learning objects, services and further environments (see Figure 2). A service element in an IMS-LD Learning Design/Opportunity is an abstract declaration of the required facility or tool, e.g. a synchronous conferencing service. A service relates to a concrete service facility available at runtime. During design time, a service has no URL assigned to it but must be given a URL when the IMS-LD Learning Design is instantiated by a local runtime service. This is because, if a service facility is bound at design time, then that specific service will have to be used by all users of all instances of the IMS-LD Learning Design. To automate the setup process of a service facility from a service declaration, the runtime data from the instantiated learning design will be translated into a configuration format used by the system providing the service if the service is to be automatically set up. It is also possible that a learning facilitator could read this information and set up the required service manually, but the intent is to alleviate the manager of this task by enabling it to be automated [14].

Since different services like discussion forum, chat, announcement etc. offer different functionalities and require different steps and parameters during setup and use, there is a dedicated description schema for each service. When the IMS-LD Specification was

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\(^1\) For further information about Assessment Methods in particular please have a look at: WP6, D6.3.
conceived, the authors decided to include the “most widely implemented and used services” [24, p.32] into the Specification. These are [14]:

- **Send-mail**: The presence of this communication service in an environment enables users to edit and to send e-mail messages to selected users of the current run.

- **Conference**: The conference service enables communication and collaboration among users; the service is divided into three subtypes:
  - Synchronous conferences (like chats and audio/video conferences)
  - Asynchronous conferences (like newsgroups, forums)
  - Announcements (one to many asynchronous conferences)

  The conference service specifies four different roles (participant, observer, conference-manager, moderator) that can be linked to learner and staff roles in the Learning Design/Opportunity.

- **Monitor**: This service enables users to look at their own and others’ properties.

- **Index search**: This service enables a Learning Design/Opportunity and its contents to be indexed and searched.

As long as most VLEs offer these services, the limited number of services included in the Specification potentially increases the interoperability and portability of IMS-LD Learning Designs/Opportunities between different systems. From a practitioner's point of view, however, this limitation comes with drawbacks: The creation of Units of Learning with intense virtual communication and collaboration may become problematic since the only services that are available for this purpose are send-mail and conference. Most forms of virtual communication can be basically covered by these services. However, there is no service description schema in IMS-LD for currently popular applications supporting collaboration and communication like blogs, wikis, shared calendars, document sharing etc.

A simple workaround that does not require any modification or extension of the IMS-LD information model would be to provide a link to or description of the required service as well as the setup and use instructions for the service as part of the description of the activity that uses the service. There are several potential problems with such an approach:

- Different users have different roles within the activity/environment that uses the service (e.g. moderator and participant in discussions). These roles need to be mapped to the roles offered by the service (if any), but the mapping cannot be enforced because there is no protocol for transferring any data between the LD player and the external service.

- Additionally the design-time provision of a static URL instead of an abstract service description means that different runs of a Learning Design/Opportunity will use the same instance of the service.

- The use of the service by users cannot be tracked by or reported back to the LD player.

In some cases it can be disputable (see e.g. [8]) that the concrete type of service used for collaboration or communication is not necessarily part of the pedagogical model, since this decision (e.g. whether to use e-mail or forum for discussion) has few pedagogical implications and can also be taken at runtime by the learning facilitator or the learners. In this view, it is not a priority to include a specific service description in the learning design.

Other approaches to use services that are not offered by IMS-LD potentially require a modification to the IMS-LD information model and/or a “bent” interpretation of the existing
XML binding and will thus neither be portable to nor runnable on any existing IMS-LD player. However, in recent years several approaches have been proposed in this area. The perceived trend upon which these developments build is that of a move towards Personal Learning Environments that are composed of small, autonomous, loosely-coupled applications (cf. [40]).

**Widgets.** In [32], [40] and [41] the authors propose a solution where widgets hosted on a widget server can be instantiated, displayed and used during a run of an IMS-LD Learning Design/Opportunity. The existing service description elements and attributes in the XML binding of IMS-LD are used to define at the design time which widget should be displayed. That is, the “parameters” attribute of the “service” element is used for specifying the required type of widget. To prototype this approach, existing systems had to be extended with widget functionality: The CopperCore Service Integration (CCSI) layer was extended with the functionality to forward requests from the LD player to the widget server. The LD player had to be updated to be able to parse the widget parameter in the manifest file. Also, the processing of replies from the server for eventual display of the widget in the browser had to be added. From a design-time perspective, the author is supported by an advertising service in the selection of available widgets from any given widget server. In this architecture the widget server acts as a mediating component between the local LD player side and the remote world of available widgets. On the widget server, additional widgets can be deployed at any time. This architecture is therefore one feasible, open standards-based way of including any imaginable type of collaboration and communication service in IMS-LD.

**Generic Services.** The proposal in [5] includes a Generic Service Integration (GSI) Specification to include additional collaboration and communication facilities in IMS-LD. The GSI Specification was prototypically implemented with Google Docs service and the .LRN system. The GSI information is integrated into the manifest XML file. Several additional elements are proposed to be part of the service element:

- Groups, which are used for group roles
- Tool, which is used to specify the tool, its functions, and permissions for groups
- Constraints, which are used to define the lifetime of the service and the multiplicity of the service (one per group/user or one for all)

Since the designer does not typically know the concrete set of services which will be available at runtime, the proposal includes a service registry where different services advertise their capabilities. The designer provides keywords that identify what the service is expected to perform (e.g. discussion, document sharing etc.). The identification of an appropriate service is done at run-time by querying the service registry with keywords specified in the manifest and automatic or manual selection of the most appropriate service.

In conclusion, the IMS-LD Specification currently offers two services that can be used for collaboration and communication: the send-mail service for e-mail communication and the conference service for synchronous and asynchronous communication/collaboration and one-way communication. The concrete appearance and handling of these services is left to the implementing LD player. Additionally, there currently lacks a mutual agreement on a way to provide richer collaboration and communication services in IMS-LD. However,

---

1 Note: Having a PLE does not substantially change the problem - some high-level description of the requested type of service is still needed if interoperability is to be guaranteed automatically (for further reading see for example the Role project: http://www.role-project.eu/Project).

2 However, it is not enough to specify that parameters can be used but there is a need to specify what these parameters mean and which vocabularies specify the permitted values.
acknowledging the fast-paced change in tools and services available on the Web and in line with the current trend towards personalised mash-up environments, current research seems to head towards light-weight integration of remote services instead of an extension of the list of services defined in the Specification.

2.2.3 Enabling Communication in IMS-LD Using Properties and Conditions

This section describes a learning facilitator-learner communication service integrated in an adaptive IMS-LD Learning Design called "The Dangerous Knowledge Tour" (DKT) designed with the ReCourse IMS-LD Editor [30].

The communication service is subservient of adaptive assessment procedures\(^1\) which bundle cognitive and meta-cognitive aspects. It is qualified as "internal" because it is instantiated by using current features of the IMS-LD Specification at its current stage of development. According to the IMS-LD vocabulary the grading of a test by a learning facilitator implies the execution of a support activity, enacted as soon as the learner has completed the test (see Figure 3: “test reading 2 open question”).

Using properties and conditions (see Chapter 2.2.1), it is possible to arrange the communication of the:

- Learner’s answer to the learning facilitator (see Figure 4: “I am done with working in principle 2”) as well as

- Learning facilitator’s grade to the system (see Figure 5: “teacher score on formative test 2”) so that it gets the necessary information (answer right or wrong) to present the next activity (either the next piece of content to study or, in case of dangerous knowledge, the previous piece of content)

so that the communication service plays a role in the adaptation process ([14]):

![Fig. 3. DKT: Location of the Communication Service](image)

\(^1\) For further information about Assessment Methods in particular please have a look at: WP6, D6.3.
ISURE: Usage of IMS-LD for Communication and Collaboration Services

Fig. 4. DKT: Enactment of the Communication Service

Fig. 5. DKT: Application of the Communication Service
3 Evaluating the Usage of IMS-LD for Communication and Collaboration Services

Based on the outcomes of Chapter 2.1, the subsequent chapter deals with a) the application of these best practice collaboration and communication services (here: combinatorial tool, forum, [micro]-blog, shared desktop environment as a kind of combinatorial tool, and wiki) in IMS-LD Learning Designs/Opportunities as well as b) an investigation of the ability of the IMS-LD Specification and corresponding best practice IMS-LD editors and players to support such collaboration- and communication-intense Learning Designs/Opportunities considering particular requirements relevant to learning facilitators’ requirements’.

The chapter is structured as follows: Firstly, the method applied is explained. Secondly, results regarding the ability of the IMS-LD Specification and corresponding IMS-LD editors and players to support collaboration- and communication-intense Learning Designs/Opportunities considering particular requirements relevant to learning facilitators’ requirements’ are provided. Finally, the results are discussed, particular recommendations towards standardisation bodies and technology providers are derived and corresponding conclusions are drawn.

3.1 Method

The main objective of this chapter is the derivation of recommendation towards

1) Course designers/learning facilitators (see Chapter 3.2: Recommending best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players)

2) Standardisation bodies (see Chapter 3.4: Recommending missing/new standard elements for potential application profiles of IMS-LD collaboration and communication services to realise a successful application of best practice collaboration and communication services considering learning facilitators’ requirements1)

3) IMS-LD technology providers (see Chapter 3.4: Recommending how to modify IMS-LD editors and players to support these best practice collaboration and communication services)

which altogether serve as a first starting point for further elaborations on potential application profiles, respectively standard elements and tool developments to better integrate collaboration and communication services into the IMS-LD Specification as well as its corresponding tools. In order to answer this objective properly, six ICOPER partners experienced in course design, learning facilitation and the IMS-LD Specification as well as corresponding editors and players were engaged. In particular, the following approach was chosen: Firstly, each partner had to design and deliver a collaboration/communication intense IMS-LD Learning Design/Opportunity by use of an IMS-LD editor and player considered to be best practice by the corresponding partner (see Table 1). Secondly, each IMS-LD Learning Design/Opportunity had to contain a best practice collaboration/communication service (see Chapter 2.1; Table 1):

---

1 For further details please have a look at Chapter 3.1: Learning facilitators’ requirements were derived during a WP5 workshop at the ICOPER General Assembly, 18th of May, 2010, Crete, where 10 ICOPER partners, all of them experienced in course design, learning facilitation and the IMS-LD Specification, respectively its corresponding tools, participated in.
Thirdly, the collaboration-communication-intense IMS-LD Learning Designs/Opportunities had to be designed according to learning facilitators’ requirements which, at the same time, served as evaluation criteria of these Learning Designs/Opportunities (see Table. 2):

<table>
<thead>
<tr>
<th>Partner/Tool</th>
<th>Giunti</th>
<th>IMC</th>
<th>KTU</th>
<th>OUNL Scenario1</th>
<th>OUNL Scenario2</th>
<th>UC3M</th>
<th>UniVie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter</td>
<td>3.2.3</td>
<td>3.2.4</td>
<td>3.2.1</td>
<td>3.2.5</td>
<td>3.2.2</td>
<td>3.2.7</td>
<td>3.2.6</td>
</tr>
</tbody>
</table>

**Tab. 1. Tool Overview**

**Learning Facilitators’ Requirements / Evaluation Criteria**

| Collaboration/communication amongst learners within a Learning Design/Opportunity |
| Collaboration/communication amongst learners across different Learning Designs/Opportunities |
| Collaboration/communication amongst learners and learning facilitators within a Learning Design/Opportunity |
| Collaboration/communication amongst learners and learning facilitators across different Learning Designs/Opportunities |
| Sharing documents amongst learners within a Learning Design/Opportunity |
| Sharing documents amongst learners across different Learning Designs/Opportunities |
| Sharing documents amongst learners and learning facilitators within a Learning Design/Opportunity |
| Sharing documents amongst learners and learning facilitators across different Learning Designs/Opportunities |

**Tab. 2. IMS-LD Learning Design Requirements: Overview**

Thereby, the investigation is geared to a clarification of a) the ability of the IMS-LD Specification as well as b) the best practice IMS-LD editors (i.e. design time) and players (i.e. runtime) applied to support such collaboration- and communication-intense IMS-LD Learning Designs/Opportunities.
3.2 Results

3.2.1 Integrating a Blog and a Forum

This IMS-LD Learning Design illustrates the application of the asynchronous communication/collaboration service category blog as a group communication tool in problem based learning for studying learning technologies.

The underlying scenario is as follows: A learning facilitator supervises learners with different backgrounds in the course “educational collaboration/communication tools”. Some learners are from the faculty of computer science and some from the faculty of social science studying pedagogy or sociology. One of the assignments of the course is writing an essay or conducting a project work on how to apply a set of pre-defined collaboration/communication tools in various learning contexts. Learners are provided with two lists of topics and are asked to choose the topic from one of the lists. The first list illustrates specific collaboration/communication tools (e.g. forum, social bookmarking, video conference, wiki, etc.) while the second list represents a selection of learning contexts (e.g. geography classroom learning in secondary school, essay writing in university psychology course, workshop on learning theories, group project work in sociological research, etc.). Those learners who choose a particular learning context have to create group blogs and invite all other learners as collaborators. These learners become moderators of their blogs and should initiate discussion on how to apply different collaboration/communication tools in a specific learning context. The learners who have chosen specific collaboration/communication tools should provide their contribution in each of the blogs by taking into account the pre-defined learning context and as well as the posts/comments of other blog contributors/readers.

The final outcome of the assignment is expected to be a generalised scenario on how to apply specific collaboration/communication tools depending on the particular learning context chosen.

Thereby, the ReCourse IMS-LD editor was applied for designing the IMS-LD Learning Design and the Sled IMS-LD player was used to execute the instantiated IMS-LD Learning Opportunity.

Figure 6 shows the final IMS-LD Learning Design with the corresponding roles per activity created with the ReCourse IMS-LD editor.

Requests for collaboration/communication are covered in the IMS-LD Learning Design/Opportunity as follows:

- Communication between learning facilitators and learners as well as amongst learners in the activity “select topic” is organised via a forum.

![ReCourse Visualisation of the IMS-LD Learning Design](image-url)
- A **forum** is also used for announcing the **blog** address and for inviting peers to join group collaboration.
- Collaboration amongst learners is done via a **blog** in the activity “present & discuss topic”.
- The activity “prepare & submit report” does not require a synchronous communication (see Chapter 2.1) and thus is organized by the help of **local-personal properties** and a **monitoring service**.

Table 3 illustrates in how far the IMS-LD Specification allows for a proper execution of the collaboration-communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>The component environment was used along with an asynchronous conference service to achieve this. Further, collaboration is achieved via group blogs. The blogging service is referenced through the URL that is defined in the learning object.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Though not planned initially, this can be achieved via using predefined tags in the group blogs and referencing to those tags in the different IMS-LD Learning Designs/Opportunities.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>This is achieved via the asynchronous conference service.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>This could be considered only if the same person takes the learning facilitator’s role in both IMS-LD Learning Design/Opportunity-instances. This person can be engaged in collaboration via the asynchronous conference service in each IMS-LD Learning Design/Opportunity instance. External services such as blogs are more flexible and could allow communication and collaboration across different IMS-LD Learning Designs/Opportunities without this limitation.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>This is achieved using the group blogs that are created via referenced blogging service and announced via asynchronous conference service.</td>
<td></td>
</tr>
</tbody>
</table>

1 This finding implies that cross-LD communication tools should be either external or possible to interface with each other.
| Sharing documents amongst learners across different Learning Designs | This can be achieved using blogs in case the predefined tags are used so learners are able to find them. |
| Sharing documents amongst learners and learning facilitators within a Learning Design | This is achieved using local personal properties and a monitor service in an environment. |
| Sharing documents amongst learners and learning facilitators across different Learning Designs | This can be achieved via the blog. |

### Runtime

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>During runtime the communication was accomplished through the use of the forum service defined in the IMS-LD Specification. The forum service was deployed with the help of Wookie widget server and forum widget.</td>
<td>Indepency between the learning progress made by learners in different IMS-LD Learning Designs/Opportunities may cause synchronisation problems and they cannot be addressed within the current IMS-LD Specification.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>As far as the same forum cannot be used for the different Learning Designs the only solution for achieving communication across different Learning Designs might be use of external tool, in our case – Blog.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>This was accomplished through discussion forum. Submission of report was implemented with the help of monitor service. Communication through the external blog could also be possible but according to the design this was planned only for collaboration among learners.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>Collaboration/communication across different Learning Designs can be accomplished via external blogging service.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>Document sharing was not planned as a separate activity within this IMS-LD Learning Design/Opportunity but it can be accomplished with the use of external blogging service as far as blogs provides with the facilities to upload and link to documents.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>Files shared on the blogs can also be accessed by the learners from different Learning Designs.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>Files with the learning facilitators are shared when submitting report using Specifications’ local properties and monitor service.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td>Though, this is not planned in the IMS-LD Learning Design/Opportunity, it can be done by sharing files on external blog.</td>
<td></td>
</tr>
</tbody>
</table>

**Tab. 3.** Blog and Forum Integration – Results Regarding IMS-LD Specification
Table 4 illustrates in how far the Recourse IMS-LD editor and the Sled IMS-LD player enable a proper execution of the collaboration/communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Design time</th>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Such components as conference and tool object provided by ReCourse were used for this purpose. The link to the blogging service was included in a tool object along with the instructions provided in the activity description.</td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Learners from different learning designs can find group blogs from different Learning Design and can collaborate with each other.</td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>The conference component was used for implementation of the asynchronous forum that was used for communication amongst learners and learning facilitators.</td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>Reference to the external blogging service was provided with the help of Tool object in ReCourse.</td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>Sharing documents was possible through the use of blogging service that was linked by providing reference in the tool object of ReCourse.</td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>Sharing documents was possible through the use of blogging service that was linked by providing reference in the tool object of ReCourse.</td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>The tools &amp; materials offered in the Open Graphical Learning Modeller (OGLM) were used for this. There, we chose the forum. Further, we implemented a “Question &amp; Answer” Add-on, and used the steps “Take test”, “Assess answers to questions”, and “View assessment results”.</td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td>Besides the use of blogs, that is mostly used for public sharing the IMS-LD local-personal properties and monitor service were used for the submission of report.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Runtime</th>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Although in the beginning we planned to use existing Sled integration with Moodle, we found out that it was not possible as the existing integration module was abandoned by its developers in 2005 and did not work with the current Moodle version. Instead we found another existing solution for using forum widget from Wookie server. Learners were able to communicate and collaborate through the use of an external blogging service blogger.com. We provided with the detailed instructions on how to create a group blog and asked learners to announce addresses on the forum, so other learners could find them and contribute with their input.</td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Though we didn’t test communication across different Learning Designs, it is possible to implement by sharing blogs addresses through the IMS-LD global property (only on the same server), or by using some external social bookmarking service with predefined tags.</td>
</tr>
</tbody>
</table>
Collaboration/communication amongst learners and learning facilitators within a Learning Design | Support activities were implemented via forum widget. Supporters could also collaborate via blogs or evaluate the progress of a learner through the implementation of properties and the monitor service in Sled.

Collaboration/communication amongst learners and learning facilitators across different Learning Designs | Communication across different Learning Designs could be done through external group blogs. This could also be possible using global properties but only within same server.

Sharing documents amongst learners within a Learning Design | File sharing was not initially planned but it can be easily done via external blog. Another possibility is to use file properties that are supported by Sled but this is much more complicated than using external service.

Sharing documents amongst learners across different Learning Designs | As it was mentioned before file sharing can be easily done via external blog and it would work amongst learners across different IMS-LD Learning Designs/Opportunities'. Use file properties would work as well but only on the same server.

Sharing documents amongst learners and learning facilitators within a Learning Design | Submission of the report was implemented through the local-personal property of IMS-LD.

Sharing documents amongst learners and learning facilitators across different Learning Designs | It was not implemented but could be done via sharing document on the blog or via global personal property of IMS-LD.

| Tab. 4. Blog and Forum Integration – Results Regarding IMS-LD Tools |  

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3.2.2 Integrating a Microblog

The example integration is used in an interactive sequencing style learning environment where learners can compete in terms of performance comparison and discuss their outcomes in a social environment. In this context, microblogging is applied for the following reasons:

- Social internal communication and collaboration: Learners can discuss their results with other learners currently active in the system, which also yields the functionality of a learning facilitator or domain expert to guide discussions.

- Social external communication and collaboration: Using the jotabl twitter widget [19] to post scores can contribute to a competition aspect of the learning environment, while a skype [34, 35, 36] or wookie wedged-based [see Chapter 2.2.2; 32, 40, 41] conference element may again be directed rather towards tutoring or more subject focused element.

![Fig. 7. Microblog Integration: Jotabl Twitter Widget](image)

Figure 7 shows the jotabl twitter widget [19] applied which is integrated into the IMS-LD Learning Design/Opportunity by use of a code snippet to be included in the xhtml source file of the corresponding learning object.

As seen in Figure 7, the implementation supports both, the synchronisation with twitter as well as the omission of using the twitter service for broadcasting purposes. The latter might be useful in terms of privacy issues. Different instances of the twitter widget can be used in order to contextualise the collaboration and communication functionality.

Table 5 illustrates in how far the IMS-LD Specification allows for a proper execution of the collaboration-communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):
### Design time

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>The twitter widget environment was tested for cross communication of participants of the same IMS-LD Learning Opportunity. The widget is embedded in an environment as part of a learning object.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>With respect to IMS-LD Specification the service is technically compliant with the existing standard, because the widget is integrated using valid xhtml code fragments that are interpreted correctly by IMS-LD players. The widget as such is a 3rd party service and as such not a part of the Specification. However, integrating it does not stand in conflict with the Specification.</td>
<td>Identity management between Learning Designs and external services is not currently supported.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>Can be done within IMS-LD using notification services (and/or wookie widgets) or using the twitter widget.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>This is one of the strong points of this solution as everybody can see each other’s messages, so there is a high awareness degree which enables facilitators to monitor and interact.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents</td>
<td></td>
<td>Not intended for this purpose, but content can be microlinked. (e.g. using tinyurl).</td>
<td></td>
</tr>
</tbody>
</table>

### Runtime

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>During runtime the communication and collaboration were accomplished through the use of the widget service after integrating into the xhtml source of the learning objects required. The deployment of this service allowed learners within a learning design to post short notices on their progress and to compete with each other (motivation factor). Collaboratively, some</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The Specification does not differentiate between contexts of collaboration/communication.</td>
</tr>
</tbody>
</table>
ISURE: Usage of IMS-LD for Communication and Collaboration Services

| Collaboration/communication amongst learners across different Learning Designs | Using the external services implemented by the twitter-based widget, a communication of learners across different Learning Designs is possible. It is a matter of content-wise suitability for finding cross-links. For example it proved to be of interest for advanced medical learners to be in touch with lower degree learners to test their explanatory skills. |
| Collaboration/communication amongst learners and learning facilitators within a Learning Design | Learners could contact their tutor/learning facilitator using the widget. |
| Collaboration/communication amongst learners and learning facilitators across different Learning Designs | Learners could contact their tutor/learning facilitator using the widget. | Difficult to contextualise. Better not to mix too many contexts. |
| Sharing documents | Not applicable for this purpose (except using microlinks to content). |

**Tab. 5. Twitter Integration – Results Regarding IMS-LD Specification**

Table 6 illustrates in how far the Recourse IMS-LD editor and the Sled IMS-LD player enable a proper execution of the collaboration/communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Design time</th>
<th>Requirements/Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>The twitter widget environment was tested for cross communication of participants of the same IMS-LD Learning Opportunity. The widget is embedded in an environment as part of a learning object. Regarding tools, in this case there is no added value, as there already exist wookie widgets that have this functionality.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>With respect to IMS-LD tools the service extends the existing tools, because the widget uses an external 3rd party service. Learners can not only communicate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**ISURE: Usage of IMS-LD for Communication and Collaboration Services**

Collaboration/communication amongst learners and learning facilitators within a Learning Design

The communication channel can even be unlinked with the learning design and used externally altogether.

Collaboration/communication amongst learners and learning facilitators across different Learning Designs

This is one of the strong points of this solution as everybody who has access to the same communication channel can see each other’s messages.

Sharing documents

Not intended for this purpose, but content can be microlinked. (e.g. using tinyurl).

**Runtime**

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>During runtime the communication and collaboration were accomplished through the use of the widget service after integrating into the xhtml source of the learning objects required. The deployment of this service allowed learners within a learning designs to post short notices on their progress and to compete with each other (motivation factor). Collaboratively, some general info about the content and structure of the IMS-LD Learning Opportunity could be exchanged.</td>
<td>Identity management services not coordinated automatically: requires users to log in separately.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Using the external services implemented by the twitter-based widget, a communication of learners across different Learning Designs is possible. It is a matter of content-wise suitability for finding cross-links. For example it proved to be of interest for advanced medical learners</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
to be in touch with lower degree learners to test their explanatory skills.

| Collaboration/communication amongst learners and learning facilitators within a Learning Design | Learners could contact their tutor/learning facilitator using the widget. |   |
| Collaboration/communication amongst learners and learning facilitators across different Learning Designs | Learners could contact their tutor/learning facilitator using the widget. | Difficult to contextualise. Better not to mix too many contexts. |
| Sharing documents |   | Not applicable. |

Tab. 6. Twitter Integration – Results Regarding IMS-LD Tools

3.2.3 Integrating a Forum

This section illustrates the integration of the asynchronous communication/collaboration service forum into an IMS-LD Learning Design/Opportunity which is designed by use of the eXact Packager IMS-LD plug-in and executed with the Sled, respectively the Astro IMS-LD player according to the principles of the social constructivist approach.

Requests for collaboration/communication are covered in the IMS-LD Learning Design/Opportunity as follows. The forum applied should provide:

- A controlled access (only assigned group members can access).
- Monitoring functionalities (learning facilitators can observe what happens in the forum in order to decide if and when to intervene for additional support).

Figure 8 shows the final IMS-LD Learning Design/Opportunity activity overview edited with the eXact Packager IMS-LD plugin (see Table 1).
ISURE: Usage of IMS-LD for Communication and Collaboration Services

Fig. 8. Forum Integration: Learner and Learning Facilitator Activity Overview
As Figure 8 shows, each learner group (“team”) has to select a coordinator (“team leader”) at the beginning of the IMS-LD Learning Design/Opportunity in order to better coordinate and progress towards the achievement of the common goal (to pass the test about the given topic).

Table 7 illustrates in how far the IMS-LD Specification allows for a proper execution of the collaboration/communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Design time</th>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Collaboration is accomplished by use of an asynchronous conference service (here: forum) which is located in an environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>This is to be achieved via the forum instance that is the asynchronous conference service within an environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>The learning facilitator (Instructor in our IMS-LD Learning Design/Opportunity) takes the Observer role in all forums (asynchronous conference services) as part of the environments.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>Support using items of the environment and/or resources of activities (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td></td>
<td>Not into the realised IMS-LD Learning Design/Opportunity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>As above (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requirements/ Evaluation Criteria</td>
<td>Accomplished (and how)</td>
<td>Not accomplished (and why)</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>Accomplished through an asynchronous conference service to achieve collaboration via a forum, the service is into an environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>This is to be achieved via the forum instance that is the asynchronous conference service within an environment. The Learning Facilitator (Instructor in the IMS-LD Learning Design/Opportunity) has the role of an Observer.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>The learning facilitator (Instructor in the IMS-LD Learning Design/Opportunity) takes the Observer role in all forums (asynchronous conference services) as part of the environments.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>Support using items of the environment and/or resources of activities (***)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td></td>
<td></td>
<td>Not in the proposed IMS-LD Learning Design/Opportunity</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td></td>
<td></td>
<td>Not in the proposed IMS-LD Learning Design/Opportunity</td>
<td></td>
</tr>
</tbody>
</table>

**Tab. 7.** Forum Integration – Results Regarding IMS-LD Specification
Table 8 illustrates in how far the best practice IMS-LD editor (here: eXact Packager IMS-LD plugin) and the Astro IMS-LD player enable a proper execution of the collaboration-communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Design time</th>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>The Editor plug-in allows to create environments and services, including the asynchronous conference for the forum, and to express service roles (participants, observer, moderator).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Forums are external links that allow participation of any authorised user.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>The Editor plug-in allows to express service roles (participants, observer, moderator).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>Forums are external links that allow participation of any authorised user.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>Support using items of the environment and/or resources of activities (**)</td>
<td>Not in the realised IMS-LD Learning Design/Opportunity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>As above (**)</td>
<td>Not in the realised IMS-LD Learning Design/Opportunity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Runtime</th>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Astro Player supports forums through Wookie Widgets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>In line of principle, as the forum is external to the IMS-LD Learning Design/Opportunity, anyone able to (authorised to) access can interact (read and post). Thus it seems that posts sent from</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>Astro Player supports forums through Wookie Widgets. Learners and learning facilitators could communicate thanks to the roles they have into the service (participant, moderator, observer).</td>
<td>Need of additional Single-Sing-On SSO. (*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>Support using items of the environment and/or resources of activities (**).</td>
<td>As above (*).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>As above (**).</td>
<td>Not in the realised IMS-LD Learning Design/Opportunity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>As above (**).</td>
<td>Not in the realised IMS-LD Learning Design/Opportunity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td></td>
<td>Not in the realised IMS-LD Learning Design/Opportunity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 8. Forum Integration – Results Regarding IMS-LD Tools
3.2.4 Integrating a Combinatorial Tool (I)

This section describes the integration of a **skype multiuser chat** [36; skype URI command see Figure 9] into a Learning Outcome-based\(^1\) IMS-LD Learning Design/Opportunity:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>skype: [targets]</code></td>
<td>focus / open skype UI</td>
</tr>
<tr>
<td><code>skype: [targets]?call</code></td>
<td>call to target(s): can be skypename, alias or PSTN</td>
</tr>
<tr>
<td><code>skype:[skypename]?chat</code></td>
<td>start chat/multichat with skypename(s)</td>
</tr>
<tr>
<td><code>skype:[skypename]?voicemode</code></td>
<td>leave voicemode to skypename</td>
</tr>
<tr>
<td><code>skype:[skypename]?add</code></td>
<td>add skypename to contactlist; show authorization dialog</td>
</tr>
<tr>
<td><code>skype:[skypename]?add?displayname=customname</code></td>
<td>add contact dialog with pre-set displayname</td>
</tr>
<tr>
<td><code>skype:[skypename]?pwdfile</code></td>
<td>open password dialog to skypename</td>
</tr>
<tr>
<td><code>skype:[skypename]?username=customname</code></td>
<td>show info [profile] for [username]</td>
</tr>
<tr>
<td><code>skype:[skypename]?chat&amp;topic=topic</code></td>
<td>opens chat with pre-set topic;</td>
</tr>
<tr>
<td><code>skype:chatcamp;id=10</code></td>
<td>open existing multichat with [id];</td>
</tr>
<tr>
<td><code>time: YYYY-MM-DDThh:mm:ss</code></td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 9.** Skype URI Handler: Commands Overview

The IMS-LD Learning Design is designed with the OGLM [25] and executed with CLIX ICOPER [3], a Learning Outcome-based learning IMS-LD learning delivery solution developed in this project.

The corresponding activity structure is depicted in the subsequent illustration whereas the skype multiuser chat is part of both activities (see Figure 10):

**Fig. 10.** CLIX ICOPER: Activity Structure – Overview

While validating the Learning Design, the OGLM acknowledged the Learning Design to be **valid**, whereas a subsequent validation with the Sled IMS-LD player [37]\(^2\) revealed the Learning Design to contain an “invalid URL” (see Figure 11):

---

\(^1\) For further information about Learning Outcomes, respectively Personal Achieved Learning Outcome Profiles please have a look at: WP2, D2.3.

\(^2\) In this section, the Sled player is used for validation, not for execution purposes due to its detailed validation protocol.
This implies the following: Even though the manifest of the IMS-LD Learning Design under consideration demonstrably turned out to be a valid instance of the corresponding IMS Content Package Scheme ([12]; see Figure 12).

```xml
<manifest
  xmlns="http://www.imsglobal.org/xsd/imscp_v1p1"
  xmlns:imsmd="http://www.imsglobal.org/xsd/imsmd_v1p0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.imsglobal.org/xsd/imscp_v1p1"
  identifier="manifest-990A4B2F-ED2E-C970-7176-434CD02B50ED0">
  <imsmd:organization xmlns:imsmd="http://www.imsglobal.org/xsd/imscp_v1p1">
    <imsmd:resources xmlns:imsmd="http://www.imsglobal.org/xsd/imscp_v1p1">
      <imsmd:resource identifier="file-41b36b18-2f93-ddb8-cd8c-13bd03cb2ca8.txt" type="webcontent" href="file://file-41b36b18-2f93-ddb8-cd8c-13bd03cb2ca8.txt"/>
    </imsmd:resources>
  </imsmd:organization>
</manifest>
```

Fig. 12. IMS-LD Learning Design: Manifest Overview

the corresponding runtime environment (RTE, here: CLIX ICOPER and Sled IMS-LD player) does not render the skype multiuser chat command (see Figure 9) in case the RTE draws on standard implementations limited to a rendering of standard protocols such as “http:” or “file:” while validating IMS-LD Learning Designs.

Consequently, the standard protocol validation in CLIX ICOPER was deactivated in order to enable a proper execution of the skype multiuser chat integration. Based on the deactivated standard protocol validation learning facilitators are enabled to execute this kind of skype multiuser chat integration whilst taking their particular requirements into account entirely (see Table 2 and 9).

Beyond, in order to make it a Learning Outcome-based IMS-LD Learning Opportunity (see Chapter 2.1 and Chapter 2.2.1: IMS-LD does support the achievement of Learning Outcomes\(^1\)), particular Learning Outcomes related to communication- and collaboration-intense learning/teaching activities were added exemplarily while instantiating the Learning Design, resulting in an IMS-LD Learning Opportunity (see Figure 13: “shape conversations”).

---

1 For further information about Learning Outcomes, respectively Personal Achieved Learning Outcome Profiles please have a look at: WP2, D2.3.
<table>
<thead>
<tr>
<th>Requirements/Evaluation Criteria</th>
<th>Accomplished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Opportunity</td>
<td>x</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Opportunities</td>
<td>x</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Opportunity</td>
<td>x</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Opportunities</td>
<td>x</td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Opportunity</td>
<td>x</td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Opportunities</td>
<td>x</td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Opportunity</td>
<td>x</td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Opportunities</td>
<td>x</td>
</tr>
</tbody>
</table>

**Tab. 9. IMS-LD Learning Design Requirements: Overview**

Fig. 13. **CLIX ICOPER: Add Learning Outcome to IMS-LD Learning Design**

After having completed the collaboration-/communication-intense IMS-LD Learning Opportunity successfully CLIX ICOPER automatically updates learners’ PALO (here: “shape conversations”) that were assigned to the corresponding IMS-LD Learning Opportunity beforehand, in a) the LMS/VLE itself as well as b) the Open ICOPER Content Space (OICS) [27] (see Figure 14) or further internet platforms (here: iGoogle) based on an ATOM Feed solution [28] (see Figure 15).
ISURE: Usage of IMS-LD for Communication and Collaboration Services

Open ICOPER content space

Shaping Conversations

Fig. 14. Publish PALO in the OICS

Fig. 15. Publish PALO in the OICS
### 3.2.5 Integrating a Combinatorial Tool (II)

This section extends the “DKT” IMS-LD Learning Design (see Chapter 2.2.3) by integrating learning facilitators’ social presence by means of a **skype button** [35] (see Figure 16):

![Fig. 16. DKT: Integrate Skype Button into IMS-LD Learning Design](image)

The social presence indicator in turn is borrowed to the recently released skype buttons and can be integrated into the IMS-LD Learning Design/Opportunity seamlessly through a cut & paste of a ready-made piece of code which is available here on the corresponding skype Website [34]. This button, located on a dedicated page, simultaneously provides a visual cue for learning facilitators’ presence and enables a prompt learning facilitator-learner interaction as soon as the parties involved allow their online status to be shown on the Web (see Figure 17):

![Fig. 17. DKT: Integrated Skype Button in IMS-LD Learning Opportunity](image)

Hence, the communication service at hand could be incorporated into an IMS-LD Learning Design/Opportunity without the necessity to change anything in the IMS-LD Specification. Thereby, learning facilitators’ particular requirements were taken into account entirely (see Table 2).
3.2.6 Integrating a Forum and a Wiki

This IMS-LD Learning Design is for studying technologies for learning. The learning facilitator will select materials regarding four technologies: twitter, SecondLife, blogs and podcasts. The materials are distributed to groups of four (so called "home teams") so that in each group one person represents one technology for learning. After the assignment, all learners who were assigned the same technology will form a group, e.g. all learners with "blog" will join together. This group is called the "expert group". Learners read the materials, discuss the content, and write down their important facts on the technology into the wiki. When finished, the learners move to their home teams. Here, each group member teaches the others about the technology in which they are an expert using the wiki as a learning aid. The team members take turns to do this. In the end, learners discuss with the learning facilitator, what the test will be like. They then take the test on all technologies for learning that were covered. Figure 18 shows the final IMS-LD Learning Design with the corresponding roles per activity (see Figure 19) altogether created with the OGLM [25].

![Fig. 18. OGLM: Activity Structure Overview](image)

![Fig. 19. OGLM: Role Overview](image)

Requests for collaboration/communication are covered in the IMS-LD Learning Design/Opportunity as follows:

- Collaboration between learners is done via **forum** (see Figure 20) and **wiki** (see Figure 21) in the activities “Expert work” and “Teach the home team”.
- Collaboration between learners and learning facilitators is done via forum in the activities “Discuss & assess” and “Review & take test”.
- Sharing of documents between learners is done via the wiki in the activity “Expert work” and is done via the forum in the activity “Teach the home team”.
- Sharing of documents between learners and learning facilitators is done via the wiki in the activities “Prepare expert round” and “Expert work”, and via properties in the activities “Discuss & Assess”, “Review & take test” and “View your assessment results”.
- Regarding the sharing between different learning designs, the idea is that learners at two different campuses of the same University learn simultaneously. The learners are

1 For further information about Assessment Methods in particular please have a look at: WP6, D6.3.
enrolled in the same course, and the same learning facilitator manages the course at both campuses via the learning platform. There are two instances of the IMS-LD Learning Design/Opportunity, which start at the same time. Collaboration between users from the two instances of the Learning Design/Opportunity takes place via the wiki (not via the forums, which are also included in the Learning Design/Opportunity). Learners from both units of learning are supposed to use the same wiki to describe their technology. If there is a need to discuss the wiki contents and setup, the learners collaborating across the two Learning Design/Opportunity instances should use the wiki’s discussion forum.

### Question:

Explain how you overcome difficulties presented, when students lack competence in using technology.

**Answer:**

I would offer an extra session in order to instruct those students and bring them to the required level of technology knowledge. In some cases, some of those students would need special attention during the course of the class.

---

### GRAIL-add on in .LRN: Forum Integration

Fig. 20.
Table 10 illustrates in how far the IMS-LD Specification allows for a proper execution of the collaboration-communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Collaboration/communication amongst learners within a Learning Design</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>The component environment was used along with an asynchronous conference service to achieve this. Further, collaboration is achieved via a wiki. The wiki is embedded in an environment as part of a learning object. The URL hosting the wiki is defined in the learning object.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>This is achieved via the wiki, which is embedded in a learning object/environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>This is achieved via the asynchronous conference service, which is embedded in an environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>The same person takes the learning facilitator role in both IMS-LD Learning Design/Opportunity-instances. This person engages in collaboration via the asynchronous conference service as part of an environment in each IMS-LD Learning Design/Opportunity instance.</td>
<td></td>
<td>This solution is a workaround. This criterion could be considered not applicable to the learning design.</td>
</tr>
</tbody>
</table>
Sharing documents amongst learners within a Learning Design | This is achieved using the wiki, embedded in a learning object/environment. |  |
Sharing documents amongst learners across different Learning Designs | This is achieved using the wiki, embedded in a learning object/environment. |  |
Sharing documents amongst learners and learning facilitators within a Learning Design | This is achieved using locipers properties and a monitor service in an environment. |  |
Sharing documents amongst learners and learning facilitators across different Learning Designs | This is achieved via the wiki. |  |

### Runtime

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
<th>Not accomplished (and why)</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>During runtime the communication and collaboration were accomplished through the use of the forum service defined in the IMS-LD Specification. The deployment of this service allowed learners from the same role group to discuss a given subject between them and, in another activity, share different knowledge with members of another role group.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Since the instantiation of the forum service is valid only for the scope of the run that the learner is being part of, this cannot be the solution for achieving collaboration/communication across different IMS-LD Learning Designs/Opportunities. In this case, the external tool (i.e., the Wiki) was the mean to acquire these characteristics through different instantiations of the IMS-LD Learning Design/Opportunity.</td>
<td>One issue that rose from this solution was the independency between the learning progress made by learners in different IMS-LD Learning Designs/Opportunities. The synchronisation provided by the acts in IMS-LD was maintained in both IMS-LD Learning Designs/Opportunities. Learners of LD1 could be discussing the different tools as experts while learners of LD2 could be already on the phase of explanation to the home groups.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>This was accomplished through different means. First, learners and learning facilitators could communicate through the forum instances. Then, learning facilitators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISURE: Usage of IMS-LD for Communication and Collaboration Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learners could obtain feedback on the progress of learners through the use of support activities, including the monitor service. Learners were given a test in this activity and learning facilitators could assess the test and provide the result to the learners. Finally, learners and supporters could also communicate through the external tool: the Wiki.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Besides the issue described for the case of collaboration/communication across learners, this evaluation case presented the problem that learning facilitators can assess only those learners belonging to the same IMS-LD Learning Design/Opportunity.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sharing documents amongst learners within a Learning Design</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As with the learners case, this was accomplished thanks to the use of the Wiki as a bridge for learners and learning facilitators to communicate and collaborate.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sharing documents amongst learners across different Learning Designs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accomplished with the use of the Wiki as an external tool. This tool provides the option to upload and link to documents, and every user with access to the wiki would be able to upload and access documents related with the IMS-LD Learning Design/Opportunity. Focusing in the Specification, this could have also been done by the use of global and role properties of type file but the sharing process wouldn’t be as smooth and understandable as it is with the wiki interface.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Also accomplished through the external tool. In this case, the alternate solution would be possible only if the IMS-LD Learning Designs/Opportunities shared all the same property space for those marked as global.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| If the problem is restricted to be solved solely with the IMS-LD Specification, this wouldn’t be possible due to the lack of communication between IMS-LD Learning Designs/Opportunities deployed in different systems. While two IMS-LD Learning Designs/Opportunities deployed in one system can make use of a global property, different systems would require a protocol to communicate these messages or documents. Therefore, it would be required to have an extension to the Specification that incorporates this protocol to send and receive information between IMS-LD
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| Sharing documents amongst learners and learning facilitators within a Learning Design | Accomplished as well through Wikispaces. Learners are able to upload documents which are available publicly to all of those sharing the same URL for the wiki. |
| Sharing documents amongst learners and learning facilitators across different Learning Designs | As in the previous cases, this was also accomplished through Wikispaces. |

**Tab. 10. Forum and Wiki Integration – Results Regarding IMS-LD Specification**

Table 11 illustrates in how far the best practice IMS-LD editor (here: OGLM) and the IMS-LD player (here: GRAIL add-on in .LRN) enable a proper execution of the collaboration-communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Design time</th>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>The tools &amp; materials offered in OGLM were used for this. There, we chose forum and learning object. The link to the wiki was included in a learning object.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Learners from different learning designs use the same wiki to collaborate. We included the same link in both learning designs.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>The tools &amp; materials offered in OGLM were used for this. There, we chose the forum. Further, we implemented a “Question &amp; Answer” Add-on, and used the steps “Take test”, “Assess answers to questions”, and “View assessment results”.</td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>We used an external wiki, which we integrated via OGLM’s Tools &amp; Materials inside a learning object.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>We used an external wiki, which we integrated via OGLM’s Tools &amp; Materials inside a learning object.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>We used an external wiki, which we integrated via OGLM’s Tools &amp; Materials inside a learning object.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>The tools &amp; materials offered in OGLM were used for this. There, we chose the forum. Further, we implemented a “Question &amp; Answer” Add-on, and used the steps “Take test”, “Assess answers to questions”, and “View assessment results”.</td>
<td></td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td>We used an external wiki, which we integrated via OGLM’s Tools &amp; Materials inside a learning object.</td>
<td></td>
</tr>
</tbody>
</table>

**Runtime**

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>GRAIL takes advantage of the Forum package included in .LRN to implement the forum service of the IMS-LD Specification. Thus, the collaboration and communication amongst learners was accomplished with this functionality.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>Learners were able to communicate and collaborate through the use of an instance of Wikispaces. As shown in the screenshot, GRAIL presents the Wiki tool within the content section of the layout, making it possible to follow the sequence of the IMS-LD Learning Design/Opportunity while accessing the different resources and tools provided for that IMS-LD Learning Design/Opportunity.</td>
</tr>
</tbody>
</table>
While accessing the discussion forum during the *discuss and assess* activity, the learning facilitator is able to participate in the forum and help the learners to advance in the course of the IMS-LD Learning Design/Opportunity.

The other way to allow supporter communicate and collaborate with learners is directly through the support activities. As the figure below shows, supporters can evaluate the progress of a learner through the implementation of properties and the monitor service in GRAIL.

Collaboration/communication amongst learners and learning facilitators across different Learning Designs

This would be possible in GRAIL using global properties only if the IMS-LD Learning Designs/Opportunities in question where all being deployed in the same .LRN installation. This was the case for the environment of this study, but the communication and collaboration among learners and learning facilitators was managed via the wiki.

Sharing documents amongst learners within a Learning Design

Although GRAIL supports the use of file properties in all of the different scopes (global, role, local, local-personal, global-personal), in this case the use of the Wiki platform Wikispaces simplified the sharing of documents and therefore, file properties were not used for this purpose.

Sharing documents amongst learners across different Learning Designs

This was acquired with the use of the Wikispaces tool. In this case, as mentioned before, GRAIL would have been able to support this requirement only if both IMS-LD Learning Designs/Opportunities had been deployed in the same .LRN installation.

Sharing documents amongst learners and learning facilitators within a Learning Design

Also accomplished through the use of the Wikispaces instance.

Sharing documents amongst learners and learning facilitators across different Learning Designs

Also accomplished through the use of the Wikispaces instance.

**Tab. 11.** Forum and Wiki Integration – Results Regarding IMS-LD Tools
3.2.7 Integrating a Shared Desktop Environment

This learning design is used to teach concepts related to grid computing. In the deployment of the learning design, learners are classified as experts in three different subjects of grid computing, they are also assigned to a heterogeneous discussion group following the jigsaw technique. The learning flow starts with the learners being provided with a research article about grid computing, which they base on to create a conceptual map regarding the topics treated in the document. Each expert reviews the conceptual map of her/his peers in order to have a group discussion. Following, learners work with their jigsaw peers, reviewing the conceptual maps of the articles they didn't read. Finally, a pyramid pattern is implemented, where the discussion takes place within a bigger group, involving different jigsaw groups; this is done repeatedly until the whole class is discussing together.

A graphical representation of this flow of activities and patterns is shown in Figure 22:

Requests for collaboration/communication are covered in the IMS-LD Learning Design/Oportunity as follows:

- Collaboration between learners is achieved through the use of different applications within a **shared desktop environment** (see Figure 23): white-board, text editor and a concept map tool. In regards of communication, learners could also make use of Skype (see Figure 24).

- Collaboration between learners and learning facilitators is achieved through the shared text editor. In this context, a shared text editor behaves in the same way than current online editor such as Google Documents and Zoho Writer. This tool allows both learners and learning facilitators to redact a document at the same time, which can be used with collaborative purposes. For example, learners can write a text while learning facilitators are able to comment on the text and make corrections simultaneously.

- Sharing of documents between learners is done through a shared file repository.

- Sharing of documents between learners and learning facilitators is achieved as well with a shared file repository.
Collaboration, communication and document sharing among different learning designs is achieved with the same tools as in the single learning design scenario. This is possible due to these tools being accessible from the learning design RTE.

Fig. 23. GRAIL-add on in .LRN: Shared Desktop Environment Integration
Table 12 illustrates in how far the IMS-LD Specification allows for a proper execution of the collaboration-communication-intense IMS-LD Learning Design/Opportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Requirements/Evaluation Criteria</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Yes, this is achieved through the use of an environment for each of collaboration/communication tool. A learning object of type „Learning tool“ was added to this environment, linking to the URL of each of the tools included in the shared desktop environment (text editor, concept map tool and white-board). For communication, a learning object was created, including an HTML file with the list of participants of the course with their Skype Names.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>This is achieved in the same way as the single Learning Design case, via the external tools included in environments as learning tools.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>This is achieved through the shared text editor included as a learning tool in an environment. This learning object points to the shared text editor tool.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>This is achieved in the same way as the single IMS-LD Learning Design/Opportunity scenario, through the use of the shared text editor included in an environment as a learning tool.</td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>This is achieved through the shared file repository, included in an environment as a learning tool.</td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>This is achieved through the shared file repository, included in an environment as a learning tool.</td>
</tr>
</tbody>
</table>
## ISURE: Usage of IMS-LD for Communication and Collaboration Services

<table>
<thead>
<tr>
<th>Requirements/ Evaluation Criteria</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>This is achieved through the shared file repository, included in an environment as a learning tool.</td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td>This is achieved through the shared file repository, included in an environment as a learning tool.</td>
</tr>
<tr>
<td><strong>Runtime</strong></td>
<td></td>
</tr>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>The communication/collaboration was achieved through the use of the environment learning tools.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>The communication/collaboration was achieved through the use of the environment learning tools. One problem that arises from this workaround is the consequent limitation of the re-usability of the learning design. The inclusion of a concrete URL to link each instance of the collaboration tools implies that those URLs need to be customised for each instantiation of the learning design, therefore the learning design must be updated with these new URLs for the learning tools in the environments. Another issue that arises from this scenario is the lack of synchronisation among the learning processes of the different learning designs. Learners are supposed to advance from one act to another at the same time, but by having different learning designs this synchronisation is lost.</td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>In runtime, this was achieved with the use of a shared repository of files. The solution for this requirement also suffers from the lack of re-usability presented in the cases of communication/collaboration.</td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>In runtime, this was achieved with the use of a shared repository of files. The solution for this requirement also suffers from the lack of re-usability presented in the cases of communication/collaboration.</td>
</tr>
</tbody>
</table>
Table 12: Shared Desktop Environment Integration – Results Regarding IMS-LD Specification

Table 13 illustrates in how far the Reload IMS-LD editor and the best practice IMS-LD player (here: GRAIL add-on in .LRN) enable a proper execution of the collaboration/communication-intense IMS-LD Learning Design/Oppportunity, learning facilitators’ requirements considered (see Table 2):

<table>
<thead>
<tr>
<th>Design time</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Reload LD Editor satisfied the need to include an URL as a learning tool within an environment and associate it to the desired activity.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>In order to have learners from different learning design instances collaborate and communicate among them, the same URLs were included in both instances.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>Reload LD Editor allowed the inclusion of the URL to the shared text editor within an environment. This environment was then associated to the learner and learning facilitator roles for them to collaborate and communicate.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>Since the text editor application was external, it was possible to reference it from the different learning design instantiations.</td>
</tr>
<tr>
<td>Sharing documents amongst learners within a Learning Design</td>
<td>Reload LD Editor allowed the inclusion of the shared file repository URL as a learning tool in an environment.</td>
</tr>
<tr>
<td>Sharing documents amongst learners across different Learning Designs</td>
<td>The same URL referencing the shared file repository was used in both learning designs.</td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators within a Learning Design</td>
<td>Reload LD Editor allowed the inclusion of the shared file repository URL as a learning tool in an environment.</td>
</tr>
<tr>
<td>Sharing documents amongst learners and learning facilitators across different Learning Designs</td>
<td>The same URL referencing the shared file repository was used in both learning designs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Runtime</th>
<th>Accomplished (and how)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration/communication amongst learners within a Learning Design</td>
<td>Although GRAIL allows the interaction among learners through the forum, in this case the need of a more visual representation such as concept maps implied the use of an external tool, having achieved collaboration through the use of a shared desktop service (VNC). The main issue in this solution is that when the learning design is needed to be instantiated again, the URLs for these tools would need to be changed in order to belong to this new instance.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners across different Learning Designs</td>
<td>By supporting the inclusion of URLs in an environment, GRAIL allowed to embed the different collaboration tools since they all are web applications (Java applets).</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators within a Learning Design</td>
<td>Since learners and learning facilitators were provided with the same URL of the shared text editor application, this requirement was achieved in GRAIL.</td>
</tr>
<tr>
<td>Collaboration/communication amongst learners and learning facilitators across different Learning Designs</td>
<td>Since learners and learning facilitators of both learning designs were provided with the same URL of the shared text editor application, this requirement was achieved in GRAIL.</td>
</tr>
<tr>
<td>Sharing documents</td>
<td>GRAIL showed correctly the link to the shared file repository and embedded the application correctly within the content section of the player.</td>
</tr>
</tbody>
</table>

Tab. 13.  
Shared Desktop Environment Integration – Results Regarding IMS-LD Tools
3.3 Discussion

The present study provides a systematic analysis of the ability of a) the IMS-LD Specification as well as b) corresponding IMS-LD editors and players to support collaboration- and communication-intense Learning Designs/Opportunities, considering learning facilitators’ particular requirements (see Table 2).

3.3.1 Discussion Regarding the IMS-LD Specification

With a view to the ability of the IMS-LD Specification to support the collaboration, respectively communication services applied, the following can be stated:

Beginning with the integration of a Blog and a Forum (see Chapter 3.2.1), the current lack of generic services and blog services required the application of an external service which was referenced to via a URL inside the defined object. In this way, the IMS-LD Learning Design became very general so that a lot of verbal instructions were provided to the learners in order to enable the autonomous setup of group blogs as well as the invitation of peers as co-editors. Although the integration of a forum was not foreseen, it appeared to be good and valuable solution for exchanging organisational information amongst learners (e.g. announce addresses of group blogs) as well as learners and learning facilitators (e.g. provide learners with the topics for assignment and organise the selection of a specific topic). In so doing, the application of forum services helped to avoid the setup of IMS-LD properties and equipped the learning facilitator with more flexibility to adapt to the actual situation of the IMS-LD Learning Opportunity. Additionally, the IMS-LD Specification does not address synchronisation issues so that the learning progress made by learners in different IMS-LD Learning Opportunities may differ and collaboration may be very limited or even impossible.

Secondly, regarding the integration of a Microblog, coordination and collaboration activities between learners and learning facilitators become more accessible. The more challenging perspective of this is the combination of different communication paradigms so that they complement each other sufficiently. It is possible to integrate a twitter widget [19] into a Learning Opportunity so that learners may use it within a particular learning activity, across different learning activities, or externally altogether. In general, using an external service (see Chapter 3.2.5: skype button) is conformant with the open specification of using xhtml documents and processing these documents in an IMS-LD player after having validated them successfully. This poses the disadvantage that the integration is possible but there is no intelligent logical linkage with the host system, for example in terms of aggregated identity management. However, using this particular solution it is possible to decouple the communication from the “publicly available” twitter channel (by setting one check box), hence allowing for more privacy and limiting the communication to the context it is intended for.

Thirdly, with a view to the integration of a Forum (see Chapter 3.2.3), the current IMS-LD Specification shows a good support for expressing collaborative services as well as related user roles. However, IMS-LD does not explicitly address the expression of “emerging roles”, in the sense of roles that start/stop within the IMS-LD Learning Opportunity (e.g. “team leader”). Thus, IMS-LD hinders learners to change their roles within a run.

Fourthly, regarding the integration of Combinatorial Tools (here: Skype multiuser chat [see Chapter 3.2.4]; Skype social presence button [see Chapter 3.2.5]), the communication services could be incorporated into an IMS-LD Learning Design/Opportunity without the necessity to change anything in the IMS-LD Specification. Thereby, learning facilitators’ particular requirements were taken into account entirely (see Table 2).
Fifthly, concerning the integration of a **Forum** and **Wiki** (see Chapter 3.2.6), some abstract thinking is required to find the correct element within the IMS-LD Specification to express a Learning Design from the pedagogical idea it originated from. Some problems occur because design time and runtime are separated, and it is not clear during design time, what functions the RTE will offer. For instance, there are two group types in the Learning Design (expert and home group), and the setup between these groups is quite specific. A person will be part of both, expert and home group, but this cannot be done randomly but must comply with a system, similar to a jigsaw. During design time, there is only the concept “role” to work with. Roles alone are not sufficient to specify this setup even though we are capable of defining minimum and maximum number of persons for the role in the imsmanifest. Therefore, more information is required to be included in a separate document by us. In this document it is specified how persons should be assigned to the groups. Additionally, we don’t know how many groups there will be during the design time. This creates uncertainty between design time and runtime. Group formation can only be done during the actual implementation, when the run for the Learning Opportunity is created. Moreover, some things cannot be specified inside the imsmanifest. For instance, if two Learning Designs are run in parallel and they both use the same wiki, it is necessary that learners from both Learning Opportunity instances take part in the wiki activity at the same time. The Learning Opportunity instances must be synchronised in a way that this is allowed. The Specification offers global properties to do so. However, global properties only work if the participating LMS/VLE have access to the repository space where global properties are stored. If this is not the case\(^1\), then global properties do not provide a solution to this problem. In addition to that, the IMS-LD Specification is flexible and allows multiple ways of interpreting or setting up a Learning Design/Opportunity. Some of the functions that the **Wiki** in the Learning Design/Opportunity fulfilled could also be operated solely using IMS-LD global properties and loc-pers properties of type file. This would have made the setup of the Learning Design/Opportunity more complicated. However, if all elements were expressed using IMS-LD instead of the **Wiki**, it would be possible to control and obtain feedback on the activities learners are performing.\(^2\) If the **Wiki** is used, no information relating to progress or finalisation can be automatically detected and passed back and forth between the run of the Learning Design/Opportunity and the **Wiki** instance. Finally, one problem when implementing a wiki in a Learning Design/Opportunity using an external wiki service is that the URL of the wiki is static. If the Learning Design/Opportunity is reused for multiple courses or over several semesters, the static URL would have to be manually updated. Otherwise, learners in the new run will see the information that former learners of the Learning Design/Opportunity have written.

Sixthly, regarding the integration of a **Shared Desktop Environment** (see Chapter 3.2.7), it is important to emphasize that the learning design used in this scenario implemented different collaborative patterns. The IMS-LD Specification was capable of supporting the whole pedagogic script, considering the support of learning facilitators’ requirements in particular. This achievement was made mostly with core components such as roles and role instances; there was also need of properties and conditions. As seen in the description of the learning design provided, the different requirements were satisfied through the use of external collaboration/communication tools or services. This approach is a workaround that provides learners and learning facilitators a way to work together through the use of a highly collaborative application, such as a collaborative concept map tool. It can be said that the

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\(^1\) Further investigations will be undertaken to elaborate in how far IMS CP allows two manifests to use the same URL for a resource.

\(^2\) Note: This is a general problem that does not only apply to Wikis. Basic LTI with simple response processing (currently under development and to be demonstrated at Educause2010 may be a useful extension for LD.
Specification does support a loose integration of external learning objects and tools; by allowing this, it lets the course designer provide the proper resources for a learner to complete a given task. In the presented case, learners follow the activities seamlessly due to having in the same environment everything that they require during the completion of the activities. This inclusion of external collaboration tools as learning objects within an environment component presents a disadvantage when the IMS-LD Learning Design is intended to be instanced in more than one run. This disadvantage is the need to predefine a URL for each external collaboration/communication tool which will be used solely by the users intended to take part of that specific run. For example, in the case of the IMS-LD Learning Design/Opportunity under study the learners were provided with the same URL to access the shared concept map application. If learners from a different and unrelated IMS-LD Learning Design instance accessed that same URL, they would collide with the learners following the first Learning Design instance. Therefore, with this approach and to solve this issue, it would be needed to modify the original IMS-LD Learning Design and manually change the shared concept map tool URL to a different one; thus affecting the basic principle of re-usability in IMS Learning Design.\(^1\) On the other hand, when users taking part in different IMS-LD Learning Designs are meant to collaborate amongst each other it arises another issue related to the synchronisation of the learning process amongst participants. In the presented scenario this would allow that learners from an IMS-LD Learning Design instance proceed to the expert review activity, while learners from the other Learning Design would still be at the individual review of the articles. This lack of synchronisation among IMS-LD Learning Designs/Opportunities would clearly disrupt the original design of the course flow.

### 3.3.2 Discussion Regarding IMS-LD Tools

With a view to the ability of the best practice IMS-LD editors and players to support the collaboration, respectively communication services applied, the following can be stated:

Beginning with the integration of a Blog and Forum (see Chapter 3.2.1), the tools applied are considered not to be appropriate for inexperienced users. Some kind of convergence between IMS-LD editors and players might be feasible in order to debug/test, respectively modify already designed elements of an IMS-LD Learning Design without having it imported into a RTE. With a particular view to the maturity of the Sled IMS-LD player, the existing integration with the Moodle forum service hasn’t been updated and thus is not compatible with the recent version of Moodle.

Secondly, with a view to Microblogs (see Chapter 3.2.2) the integration of an external service proves a high degree of versatility and extensibility of the general approach. While collaboration and communication within the same IMS-LD Learning Opportunity is nothing new, the integration of the Jotabl Twitter Widget [19] enables learners as well as learning facilitators to use one service for internal as well as cross-IMS-LD Learning Opportunity collaboration/communication purposes, or a combination of both, respectively as an interface to external partners.

Thirdly, with a view to the integration of a Forum (see Chapter 3.2.3), the IMS-LD editor used (here: eXact Packager IMS-LD plug-in) was found to easily support course designers in designing IMS-LD compliant Learning Designs. On the other hand, results regarding the IMS-LD players applied show the following: Whereas the Sled IMS-LD player seems to rely on external facilities for the forum service, the Astro IMS-LD player features internal support for forums via Wookie widgets (see Chapter 2.2.2). However, communication and

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\(^1\) Note: It may be worth to consider more generally to exchange IMS-LD Learning Design templates which need to be instantiated to get playable IMS-LD Learning Opportunities.
collaboration support appears to be limited in both runtime environments. Regarding the Astro IMS-LD player this seems mainly due to the fact that the widget-based forum service cannot be shared across different IMS-LD Learning Design instances. In addition to that, different users (roles) of the same IMS-LD Learning Opportunity share the same forum instance for a given IMS-LD Learning Opportunity. Furthermore, some SSO functionalities are required in order to be able to use "external" forums (forums spread across the Internet). One could think about some "quick" login mechanisms with username and password given as parameters into the forum URL but this shouldn't be the solution of the problem as it is a quite risky way to proceed.

Fourthly, concerning the integration of Combinatorial Tools (here: Skype multiuser chat [see Chapter 3.2.4]; Skype social presence button [see Chapter 3.2.5]), no problems occurred during design time. However, during runtime, the standard protocol validation of the IMS-LD player (here: CLIX ICOPER) was disabled so that learning facilitators are enabled to execute IMS-LD Learning Opportunity properly whilst taking their particular requirements into account entirely (see Table 2).

Fifthly, regarding the integration of a Forum and Wiki (see Chapter 3.2.6), no problems were encountered when using the OGLM. Regarding the GRAIL add-on in .LRN, a small fix is needed when additional runs are created for the same IMS-LD Learning Design. If this IMS-LD Learning Design contains, for instance, an asynchronous conference service, the new run will draw onto the same instance of the conference service. This means that all previous messages from the former run are still contained in the service when the new run is instantiated. A better situation is that the conference service receives a new instance for every new run of the IMS-LD Learning Design.

Finally, regarding the integration of a Shared Desktop Environment (see Chapter 3.2.7), the following can be stated: Regarding the Reload LD editor, the editor is appropriate to design the presented IMS-LD Learning Design/Opportunity. Thereby, no bugs or errors were reported by the software. When focusing on the ease of use of the tool, the Reload LD editor does present some issues: The first one is that the user interface is practically a graphical representation of the IMS-LD Specification. This implies the following: In order to use the editor properly, the course designer has to be familiarised with the IMS-LD Specification’s structure. A second problem was experienced regarding the use of properties and conditions within the IMS-LD Learning Design. In particular, in order to include elements such as special tags defined by the IMS-LD Specification to display or request property values in resources of type imscontent the course designer, respectively learning facilitator must open the manifest generated by the editor and look for the identifier of that property. Regarding conditions, the addition of a (new) condition is treated as the creation of a structured tree which makes its use very difficult for novice users. With a view to the GRAIL add-on in .LRN IMS-LD player it was able to deploy the present IMS-LD Learning Opportunity without any problem. Nevertheless, there is one detail that can be seen as a problem in many scenarios. Once an IMS-LD Learning Design is deployed in a RTE in the shape of a Learning Opportunity, no modifications of the content as well as the Learning Opportunity itself can be undertaken by the course designers/learning facilitator.¹

¹ Note: In case an IMS-LD editor could export a course backup, this backup would not use all IMS-LD possibilities but would provide a form of content that could be really reused without further IMS-LD knowledge.
3.4 Recommendations

Based on the previous chapter, the following recommendations are formulated towards:

1) **Standardisation bodies** ( Recommending missing/new standard elements for potential application profiles of IMS-LD collaboration and communication services to realise a successful application of best practice collaboration and communication services considering learning facilitators’ requirements)

2) **IMS-LD technology providers** ( Recommending how to modify IMS-LD editors and players to support these best practice collaboration and communication services)

3.4.1 Recommendations for Standardisation Bodies

**R5.1. Need for communication across different IMS-LD Learning Opportunities deployed in different RTE.**

There is a lack of communication across different IMS-LD Learning Opportunities deployed in different RTE. While two IMS-LD Learning Opportunities deployed in one RTE can make use of a global property, different RTE would require a protocol to communicate these messages or documents. Therefore, we recommend an extension to the Specification that incorporates this protocol to send and receive information across different IMS-LD Learning Opportunities (deployed in different RTE), as a new kind of service.

**R5.2. Need for synchronisation across different IMS-LD Learning Opportunities.**

We recommend that the IMS-LD Specification should address synchronisation issues when collaboration/communication amongst learners, respectively learners and learning facilitators across different Learning Designs/Opportunities is required (e.g. the use of a particular [group] blog, [group] chat, etc.; see for example Chapter 3.2.1). Synchronisation issues, for instance, may occur in case of basic courses (e.g. introduction to mathematics, physics, etc.) which are conducted at a particular point in time within a semester and attended by students from various backgrounds/Learning Opportunities (e.g. biology, bioinformatics, chemistry, etc.). However, beyond a mere IMS-LD-centred synchronisation of Learning Opportunities, synchronisation issues may also be relevant to the coordination of IMS-LD compliant and other kinds of Learning Designs (e.g. build with a Learning Activity Management System [LAMS]¹).

**R5.3. Need for better integration of external tools or services into IMS-LD Learning Designs/Opportunities.**

Based on related work [5, 6] we recommend that there is a need to integrate more closely external tools or services into IMS-LD Learning Designs/Opportunities. This integration of services would provide a controlled way to request the location of a new instance of the service as well as the communication of data to and from this service. In the presented scenario “Integrating a Shared Desktop Environment” (see Chapter 3.2.7) such functionality would have allowed the inclusion of the required external tools (collaborative text editor, concept maps and white-board) and could also be a starting point for solving the synchronisation issue between different IMS-LD Learning Designs/Opportunities (see also R5.2). The latter one would require the creation of a communication service that would allow different Learning Designs/Opportunities send and receive predefined data structures, such as their activity statuses and/or their properties.

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¹ For further information about LAMS please have a look at: http://www.lamsfoundation.org/index.htm.
In general, the facilitation of potential integrations may be best supported by a stakeholder-oriented, strong community (see for instance the LAMS community, promoting (best practice) show/use cases and technical integrations of LAMS with other RTE such as Blackboard, Moodle, Sakai, .LRN, etc.).

R5.4. Need for an element that supports the definition of “emerging roles”.
We recommend that the IMS-LD Specification should enable the definition of “emerging roles” as roles do appear and/or disappear within an IMS-LD Opportunity (e.g. see Chapter 3.2.3: “team leader”).

R5.5. No need for an element that supports person assignments to roles.
Regarding person assignment to roles we recommend that it would be hard to define an element in an abstract way that supports person assignment to roles. This kind of explicit specification would fast get complicated; we thus do not deem it necessary adding such an element to the IMS-LD Specification (see Chapter 3.2.6).

3.4.2 Recommendations for IMS-LD Technology Providers

R5.6. IMS-LD players have to ensure a high level of accessibility.
We recommend that IMS-LD-related tools should ensure the provision of a minimum level of accessibility in their interfaces. This characteristic is somewhat more critical in the IMS-LD player, since it is intended to be used by a broader set of people. By providing this characteristic, it is possible to create an adaptive IMS-LD Learning Design/Opportunity, being sure that even learners and learning facilitators with physical disadvantages will be able to participate in the Learning Opportunity without major problems.

R5.7. IMS-LD tools have to be more user-friendly.
The current features of the ReCourse LD editor are quite advanced but still too complicated for inexperienced users. For instance, the design of interactions by use of properties could be made more user-friendly, e.g. by applying visual elements (see for example Chapter 3.2.1). In order to avoid the limitations of the Reload LD Editor we recommend a more user-friendly interface and process to display or request property values in resources of type imscontent should be provided. Additionally, the process of adding new conditions in the IMS-LD Learning Design method should be simplified (see Chapter 3.2.7). The same may count for a better and more user-friendly integration of external tools or services into IMS-LD Learning Designs/Opportunities by use of easy-to-use dashboards in the corresponding IMS-LD editor and/or player (see also R5.3, R5.8).

R5.8. IMS-LD players should better exploit the potential of their underlying RTE.
We recommend that IMS-LD players should make use of functionality already implemented and available in the RTE where the IMS-LD player is being developed. In the case of GRAIL (see Chapter 3.2.7), by being embedded within a LMS, the user management issue was already addressed by the LMS itself and it was only needed to create relationships between the members of a Learning Opportunity and the IMS-LD Learning Design instances. Another functionality that was reused is the existing file storage package of the OpenACS/.LRN framework; this module was used by GRAIL to handle the resources included in the IMS-LD Learning Design/Opportunity, so the import and retrieval of these files is as simple as

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invoking a couple of functions. The final example of the reutilization of functionality is the use of the forum module provided in .LRN, this module provided a direct implementation of the IMS-LD collaboration/communication service “forum” (see also R5.3 for a better integration of external tools or services into IMS-LD Learning Designs/Opportunities which are particularly not part of the underlying RTE in order not to overload it but to ensure high levels of flexibility).

R5.9. IMS-LD editors and players should converge to some extent.
We recommend some convergence between IMS-LD editors and players in order to debug/test, respectively modify already designed elements of an IMS-LD Learning Design without having it imported into a RTE (see Chapter 3.2.1 and Chapter 3.2.7). This would allow to provide a minimum level of flexibility and allow minimum changes once the IMS-LD Learning Design has already been deployed in the player; thus, facilitating a way to correct misspellings in the learning content\(^1\) or change slightly the flow of activities in the learning design.

R5.10. IMS-LD technology providers have to commit to an integration of IMS-LD players in already existing RTE.
We recommend that ad-hoc integrations of IMS-LD players in already existing RTE (LMS/VLE) should not be undertaken unless support for these features is committed by LMS/VLE developers (see for example Chapter 3.2.1).

R5.11. Need for enhanced identity management.
We recommend that the identity management should be enhanced by use of a synchronisation between the (collaboration/communication) services applied, possibly by use of OpenID (see for example Chapter 3.2.2 and Chapter 3.2.3; see also R5.2). This may affect both, the IMS-LD Specification (the identity model needs to be extended) as well as the corresponding tools (the OpenID service needs to be integrated).

R5.12. A central management of generated data during runtime is needed.
We recommend that generated data (of external services) per run such as forum posts of external collaboration/communication services (e.g. forum) or tags for contextualising (e.g. twitter) feeds should be managed centrally in the RTE, as convention for identification (see Chapter 3.2.2).

R5.13. A wider application of dynamically generated widget-based services is needed.
We recommend the application of widgets that are independent from specific RTE and allow the implementation of separate services (see for example Chapter 3.2.1). Thereby, the dynamic creation of widgets may spare users to log in the service provided separately or to adjust the settings themselves (see for example Chapter 3.2.2 and Chapter 3.2.3). The latter one would simultaneously imply the extension of the IMS-LD Specification as well as the modification of already existing IMS-LD players with corresponding interpretation functionalities.

R5.14. IMS-LD tools should execute non-standard-compliant protocols or make course designers aware of their incompatibility.
We recommend that IMS-LD players/RTE should execute standard protocols (e.g. http, file, ftp) as well as non-standard-compliant ones such as the skype URI handler (e.g. by

\(^1\) For further information about Learning Content as well as its (best practice) reuse in particular please have a look at: Connolly, T.: D4.1 - Content-development methodologies Survey. http://www.icoper.org/results/deliverables/D4-1, accessed at: 2010-12-10.
integrating corresponding control panels into the player/RTE; see Chapter 3.2.4). If such a support is not possible, IMS-LD editors should at least bring the use of non-standard-compliant protocols such as the skype URI handler to course designers’ attention during design time so that they may intervene timely (e.g. by integrating corresponding control panels into the editor; in analogy to the Sled IMS-LD player).

R5.15. Need for an element that supports the definition of “emerging roles”. We recommend that IMS-LD players/RTE, should facilitate the definition of “emerging roles” as roles do appear and/or disappear within an IMS-LD Opportunity (see also R5.4; e.g. see Chapter 3.2.3: “team leader”).
4 Conclusions

The IMS-LD Specification as a language for describing complex, multi-role oriented learning arrangements will only unfold its whole potential in case it enables course designers as well as learning facilitators to include and support a wide range of new (and changing) communication and collaboration in standardised Learning Designs/Opportunities in order to benefit from reusability and interoperability even if there are only a few pre-specified services within the IMS-LD Specification available. Thereby, the special focus, and thus the achievement, of this ISURE are:

- Presentation of best practice collaboration and communication services in general as well as a state of research concerning collaboration and communication services in relation to the IMS-LD Specification.

- Evaluation of the ability of the IMS-LD Specification as well as best practice IMS-LD editors and players to support these best practice collaboration and communication services in best practice learning and teaching scenarios, learning facilitators’ requirements considered.

Hence, a comprehensive set of recommendations towards the following stakeholder groups was derived:

- **Course designers/learning facilitators** (see Chapter 3.2: Recommending best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players)

- **Standardization bodies** (see Chapter 3.4: Recommending missing/new standard elements for potential application profiles of IMS-LD collaboration and communication services to realise a successful application of best practice collaboration and communication services considering learning facilitators’ requirements

- **IMS-LD technology providers** (see Chapter 3.4: Recommending how to modify IMS-LD editors and players to support these best practice collaboration and communication services)

These recommendations serve as a first starting point for further elaborations on potential application profiles, respectively standard elements and tool developments to better integrate collaboration and communication services into the IMS-LD Specification as well as its corresponding tools (IMS-LD editors and players).

This work shall stimulate future research, especially regarding:

- The communication between (different) IMS-LD Learning Opportunities deployed in different RTE

- The synchronisation between (different) IMS-LD Learning Opportunities

- A better integration of external tools or services into IMS-LD Learning Designs/Opportunities

- Elements that support the definition of “emerging roles”

- More user-friendly IMS-LD tools

- A better exploitation of the underlying RTE

- A convergence of IMS-LD editors and players
The execution of non-standard-compliant protocols via IMS-LD players to better support combinatorial communication/collaboration services such as the skype URI handler

Such research efforts may contribute to the eagerly awaited breakthrough of the IMS-LD Specification and its corresponding tools.

To conclude, with a particular view to the IRM, this ISURE primarily contributes to the data and the guidance level [33]. This is due to the fact that the recommendations for potential application profiles of IMS-LD collaboration/communication services derived in Chapter 3 primarily contribute to the IRM data level. Beyond, as Chapter 3 also recommends best practice collaboration and communication services and their actual use in best practice IMS-LD editors and players, this ISURE contributes to the IRM guidance level as well [33].
5 References


ISURE: Usage of IMS-LD for Communication and Collaboration Services


