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# A DIFFERENT PERSPECTIVE IN BUILDING TOOLS TO COLLECT AND SHARE EDUCATIONAL RESOURCES

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Until now, a large amount of effort has been spent on structuring educational repositories. Standard metadata for learning objects have been provided and large databases have been deployed both from academia and private organizations following mainly a content-centric approach. Vice-versa, a pedagogy-centric approach to the collection and sharing of learning resources still remains under-investigated. In this paper, we provide a different perspective on repositories for education, having as a central point the "educational experience," i.e. a detailed and structured case study by which teachers and researchers in the educational field can understand where, when and how the digital material was used, and what educational benefits were obtained. We describe a framework by which educational experiences conducted in real classes of all levels of schooling can be gathered and shared. We provide readers with a validation and a qualitative and numerical evaluation of the approach.

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## 1 Introduction

During the years, large repositories of educational materials have been deployed both from academia and private organizations. However, many valuable resources are difficult for most users to discover and reuse in an efficient manner because excellent course materials are "hidden" within Learning Management Systems (LMSs), streaming media servers, and online collaboration tools. To make easier for teachers and students to discover relevant learning resources, authorities and/or companies in many countries have funded Web based repositories. The hosted resources can be any type of learning content from "traditional" textbooks to Web sites, but most countries focus on digital learning objects in order to encourage the teachers' development in innovative learning styles (Wenk, 2010).

What is evident by several surveys done inside many school institutes (Nash, 2005) is that mere sets of learning objects, even if well documented, are useless building blocks if not complemented by their "context of use". Indeed, the educational goals, the learning style, and the organization (workflow) behind the single learning objects published in the educational repositories are often omitted or poorly structured. The Learning 4 All (L4ALL) project (Paolini, 2011), a 4 years Italian research project, has provided a different perspective on repositories for education (Bucciero, 2012), having as a central point the "educational experience": a detailed and structured case study by which teachers and researchers in the educational field could understand where, when and how the digital material was used, and what educational results and benefits were obtained.

The main focus of the L4ALL project was on innovative technology-based educational experiences, with the long-term goal of understanding how technology coupled with skilful pedagogical solutions can help to innovate and improve learning (in all possible senses) at school (at all levels). Instancing and maintaining a repository of innovative educational experiences – actually carried on by real teachers, in real-life situations – raise a set of challenges: (i) a data model describing a case study should provide end users with crucial information such as goals, implementation, benefits, and context, while supporting a wide range of educational materials and disciplines; (ii) evidences from hundreds of experiences would be collected from worldwide in the future, so feasibility and cost considerations as well as scaling issues should be taken into account in the organizational model; (iii) a constant evolution of the processes behind the case studies capturing, due to the experience gained on the field, should be supported by a highly robust and flexible collaboration tool.

In this paper, we propose the collaboration and technological framework we experimented to schematize and share empirical evidences collected from

a high number (286 at the time of writing) of technology-based educational experiences conducted in Italian classes of all levels of schooling. The framework has 3 main components: a static dimension (the data model of the educational experience), a dynamic dimension (the consortium's organizational model), and a technological dimension (the collaboration system based on the Alfresco open source software).

The paper is organized as follows: section 2 reports on key related works in the area of repositories for education. Section 3 gives a conceptual overview of the L4ALL project. Section 4 provides detailed data model, process design and implementation. In section 5 we evaluate the result, giving quantitative details. The conclusions in section 6 summarize our key messages and sketch future research directions.

## 2 Related work

The importance of sharing the effort, material and human in critical moments, like the present, has been highlighted (De la Camara Delgado, 2012). In the mid-1990s, relatively simple learning objects were made available informally, as instructors shared syllabi, lesson plans, and learning activities. Later, more complex and/or topic-specific repositories came into existence as museums, journals and magazines, educational television, and other organizations placed content on the Web, and encouraged it to be used for educational purposes.

Large repositories of learning objects are now available. MERLOT (Shell, 2002) is a leading archive for higher education that provides tools for user comments and peer reviews. CAREO (Neven, 2012) is a collection of Web-based multidisciplinary teaching materials. Wisc-Online (Wisc, 2000) houses the online resources supporting Wisconsin's technical colleges. Spurred by the development of the "Learning Object Metadata" standard by the IEEE Learning Technology Standards Committee (IEEE LTSC LOM), numerous initiatives have been launched in academic and corporate contexts (Queirós, 2013; Primo, 2012; Leinonen, 2010).

Learning object repositories can be difficult to navigate and the educational material difficult to integrate into online courses, indeed it quotes Beaven (2013) which talks about studies that propose a qualitative enquiry to investigate use and reuse of educational resources. Even though many educational technologies and services have been provided to enhance the educational pedagogy, in contrast with what is expected, a fall in the participants and subscribers to these educational technologies was recorded in many different studies among students and instructors (Jones, 2009; Willems, 2007; Cuthrell, 2007). These studies have also identified that the reason for such drop was the "one-size-fits-all" approach.

Moreover, authors observe that the tendency of current repositories is to retain content in the form of broad mix of text documents, video, audio, graphics etc. (EDRENE, 2009). What is almost clear is that educational repositories are mainly created to support the lifecycle of learning resources, often characterized by metadata (Lehmann, 2008), or ready-made courses, but they mostly fail providing a whole, fully described and reproducible learning experience, that can draw when, where and how materials, digital or not, were used, how the learning process was organized, what educational goals were planned, which educational benefits were generated, and what was the role of the technology.

Starting form these considerations we defined the main requirements of the L4ALL collaboration and data model.

## 3 The L4ALL project

The L4ALL is a 4-year (2008-2012) research project funded by the Italian Ministry of Education, University and Research (MIUR) that involved 7 partners, covering different fields of expertise: ICT, pedagogy and teaching. The project has investigated the impact of technology on education at school, advocating the following basic ideas: (i) it is worthwhile to share (worldwide) empirical evidence about technology-based educational experiences; (ii) empirical evidence should consist of case studies, i.e. (technology-supported) educational experiences, actually carried on at real school; (iii) each case study should provide crucial information such as goals, implementation, benefits, and context.

To make easier the collection of case studies, a repository has been created. The repository of educational experiences can be useful for different communities. Researchers can access good empirical findings without the need to create new projects and spend large efforts. Teachers, educators and trainers can have a large number of well-interpreted case studies. Policy makers, supervisors and authorities can have supporting evidence for checking current decisions and policies. Teachers and principals can find,source of inspiration, for new activities.

The first decision taken at the beginning of the project was on how (pragmatically) to collect evidence about innovative educational experiences in school. It was needed to collect evidence from hundreds of experiences from all over Italy and worldwide, so feasibility and cost considerations were taken into account. It was opinion of project partners that a combination of a “story” told by a teacher and an “interpretation” of the story by an expert (researcher) seemed the most reliable method of research. So it was decided that each case study had to include a synopsis, i.e. a briefly describing the case study, a classification according to an agreed taxonomy, and additional material for a full understanding. The latter may include interviews of teachers (audio files),

transcription and abstract of the interview, material created by the teacher or during the educational experience, organized analysis of the project. In some cases evidence is collected both at the beginning ("expectations") and at the end ("results").

Beside the collection, one of the fundamental expected outcomes of the L4ALL project was a smart search interface. Partners agreed that tagging experiences using fixed taxonomies would help teachers in retrieving stories of interest, and researchers in interpreting evidence from educational experiences. Five sets of tags have been defined and organized in taxonomies accordingly to the need of teachers, principals and re-searchers: TT-0, for Italian managers and supervisors, who try to understand the correlation between various variables and their spread; TT-1: for Italian teachers, who try to identify the experiences of inspiration; TT-2: for foreign teachers, i.e. the English version of TT-1; TR-1: for Italian researchers, who try to understand the phenomenon as a whole, or to identify characteristics of the experiences of specific interest; TR-2: for foreign researchers, i.e. the English version of TR-1.

In consideration of the above, a multi-profile repository was needed to present the same objects to different audiences: an internal interface for the L4ALL project partners, who create and manage the experiences and collect the material; a search interface for teachers, principals and researchers; a tagging interface, needed to produce the experience metadata.

In the next section we provide a formal description of the data model and collection processes behind the repository of educational experiences.

## 4 Data model and collection process of educational experiences

Trying to design the most suitable collection model for educational experiences, both static and dynamic aspects have been taken into account. We specified the former (which concerns on how the information should be stored within the repository) as "experience data model", and the latter (which concern on how partner collaborate and organize their work) as "activity workflows" (i.e. processes).

### 4.1 Experience data model

Data objects within the L4ALL repository are not simple content files or learning objects but educational experiences. An experience is an aggregation of resources about the implementation of an innovative educational format done by a teacher (or a group of teachers) in a school. The type, the number and the structure of such resources within an experience closely follow the schema depicted in Fig. 1. An experience contains an expectations interview

(optional) and a results interview. An interview is a set of resources obtained talking with the teachers who implemented the format. The expectations interview is taken before the format is implemented and reflects what the teachers expects executing it (e.g. students attention increase or class cohesiveness). The results interview is taken after the format is implemented and reflects the actual outcomes.

Both interviews include a transcript interview, which is the transcribed and filtered version of the interview. The interviewer can decide if it is worth to extract relevant or interesting sections in a specific document called "abridged interview". Interviews' contents can be the audio recording, resources used during the experience and all the produced results. A FEE (FEatures Extraction) form is derived from both interviews. A FEE form is a schema for structuring the relevant information hidden in an experience' set of resources (e.g. features of the whole class, the school's social/cultural/economic context, the rationale behind the experience).

In addition to the expectations and to the results FEE form, also a comparison and an experience FEE form are defined; they are directly related to the experience rather than to an interview. The comparison FEE form summarizes the main differences between the expectations and the results, putting in evidence the distance between what the teacher expected what s/he has obtained or observed. The comparison FEE form is a very useful and powerful tool; for example, it allows highlighting also the unexpected benefits obtained during the format implementation.

After all the material about an experience is collected and processed, the responsible staff of the repository analyzes it and compiles the experience FEE form, putting in evidence all the distinctive features about the experience, seen as a whole. So, if someone (e.g. another teacher) wants to read something summarizing the organization and the outcomes of an experience, the experience FEE form is the first resource to acquire.

The experience has also a set of "attachments", i.e. the materials produced during the experience (e.g. a multimedia presentation, a set of drawings, a movie). Each of the described objects has a minimal set of metadata aimed at fast identifying the material before downloading it.

All of the taxonomies contains three tag categories: general classification, resources and methodological criteria. The general classification subcategory deals with the objective classification of the experience, i.e. the school level, the discipline, the duration of the experience, and the effort (in time) spent by both teachers and students. The resource subcategory deals with the tools (hardware and software), which have been used within the experience (e.g. a PC, a tablet, a word processor, a smart board), and the output produced at the end of the experience (e.g. a multimedia presentation). The methodological

criteria subcategory deals with the pedagogical aspects of the experience. It covers both organizational aspects (e.g. strategy of teaching, organization of the work groups, the used workspaces), and educational aspects (i.e. the observed educational and psychological benefits, and raised problems).

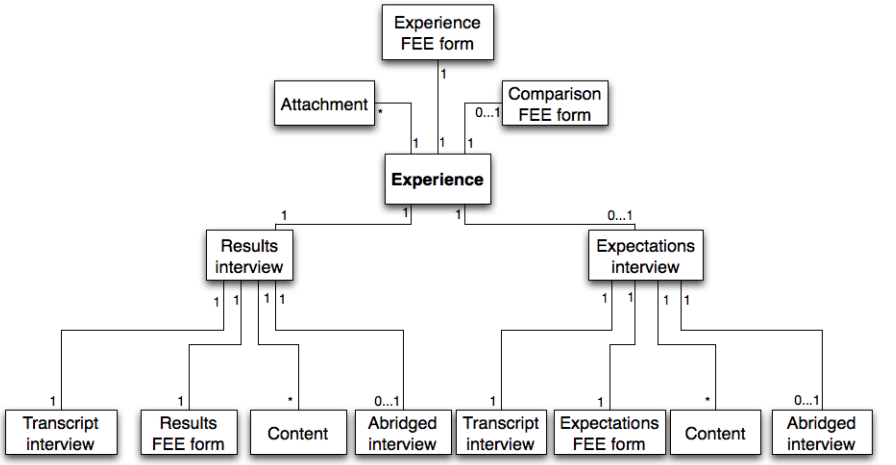



Fig. 1 - Data model of an educational experience

## 4.2 Activity workflow

The L4ALL consortium is lead by a coordinator partner, which orchestrates the work of the others partners. Each L4ALL partner is responsible of a set of experiences; a partner may also play the role of editor, i.e. it reviews and tags other experiences.

Four sub-processes compose the collection and sharing of educational experiences: “interview”, “review”, “tagging” and “publishing”. In the interview sub-process, the responsible L4ALL partner, once carried out the interviews, per-forms the transcription and compiles the FEE forms, then it upload its works to the repository. After this phase, the assigned L4ALL editor proceeds with the reviewing of the FEE forms, in order to ensure high quality to the produced materials. Later, another L4ALL editor performs the tagging of the experience FEE forms in order to ease the search when they will be published on to the search interface. Finally, the L4ALL coordinator publishes the experience on to the search interface of the repository. In Fig. 2, the processes are shown in a greater detail.

When the educational experience is concluded, the result interview is carried out and the partner produces the transcription, the result FEE form and, optionally, the abridged interviews. Thereafter, the partner compiles the comparison

FEE form. After all the material related with the experience is collected and processed, the responsible staff analyze it and fills the experience FEE form. Finally, all the produced artefacts are uploaded to the repository. At this stage, the experience is only visible from the repository's back-office. Afterwards, the editors can download all the material from the repository and can proceed reviewing it. At this point, the experience FEE forms are ready to be tagged with TT-0 ÷ TR-2 taxonomies.

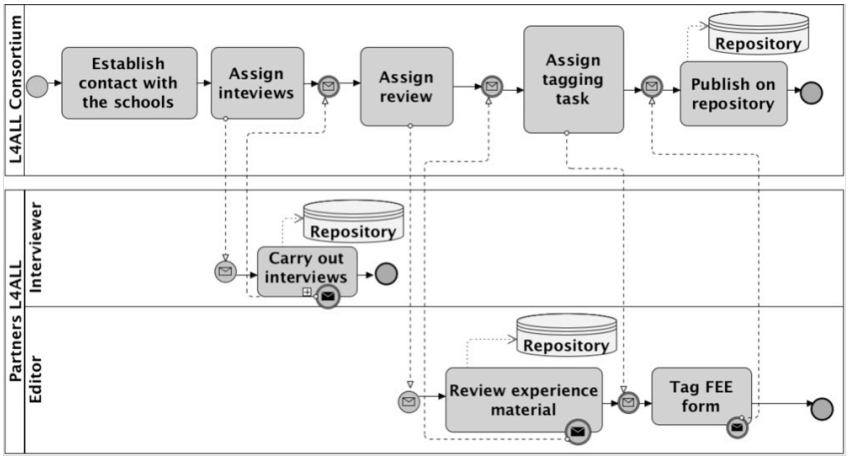



Fig. 2 - The "Collect and share educational experience" process model

In the tagging sub-process, the coordinator assigns to partners the experiences that need to be tagged. Once these are downloaded from the repository, the editor partner performs a thorough analysis on experiences in order to identify the tags that could be attributed. The output of this activity is a Microsoft Excel (xsl) file in which the experiences are listed along with the assigned tags. This is forwarded to the coordinator who approves and uploads it on to the search interface.

Finally, the coordinator can export the experience, in the means of metadata and contents, to the search interface.

## 4.3 Implementation

Being the flexibility towards multiple evolutions of the process a strong requirement, we have chosen to implement the L4ALL repository exploiting an existing, affordable and highly configurable tool: the Alfresco Enterprise Content Management (ECM) (http://www.alfresco.com/).

Alfresco is a leader ECM platform, widely adopted by both enterprise and

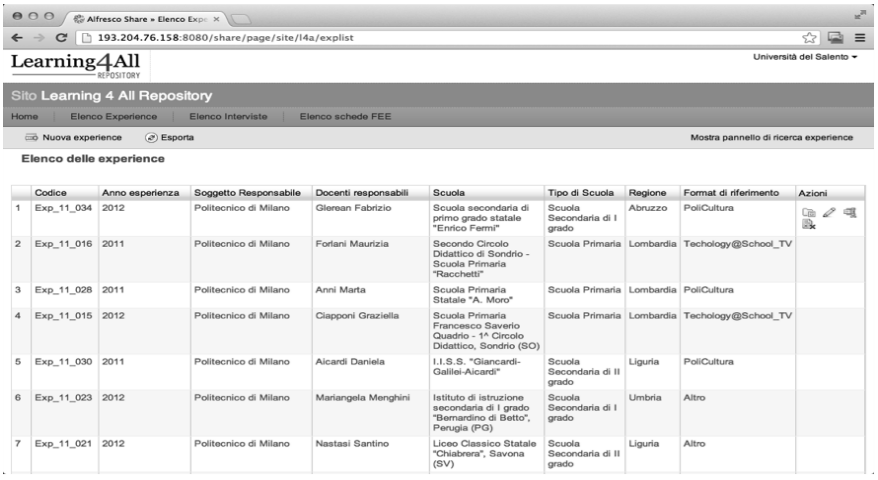
public corporations. Since the first release as a simple document management system in 2005 it has evolved a lot, adding rich features such as Web content management, versioning, records management, image management, workflow management, and so on. The Alfresco Community Edition is free and LGPL licensed open source software. In Alfresco, the repository interfaces are highly decoupled from the core document management, so it enables the creation of multiple custom interfaces towards a unique repository. Alfresco provides built-in user profiling management and configurable workflow management. We released five versions of the repository without a significant re-working effort.

The search interface mainly intertwines tag-based, full boolean, weighted and visual search strategies, to provide a rich research user experience. The tagging experts use both the internal and the search interface: they download the experiences to be tagged from the Alfresco repository, uses QSR NVivo 9 (http://www.qsrinternational.com), a tagging software installed on their desktop PCs, then export the tags to the search interface.

## 5 Validation and evaluation

Part of our effort was spent to validate the repository. We report three types of validation activities: (i) functional validation, (ii) data model validation, and (iii) process evaluation.

Functional validation activities that have been conducted both “in vitro” and “in vivo” by partners collecting real educational experiences. The internal repository can be found at Internal Repository (Fig. 3). The external repository is available at External Repository.




| | Codice | Anno esperienza | Soggetto Responsabile | Docenti responsabili | Scuola | Tipo di Scuola | Regione | Format di riferimento | Azioni |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Exp_11_034 | 2012 | Politecnico di Milano | Glerean Fabrizio | Scuola secondaria di primo grado statale "Enrico Fermi" | Scuola Secondaria di I grado | Abruzzo | PoliCultura | |
| 2 | Exp_11_016 | 2011 | Politecnico di Milano | Forlani Maurizia | Secondo Circolo Didattico di Sondrio - Scuola Primaria "Racchetti" | Scuola Primaria | Lombardia | Techology@School_TV | |
| 3 | Exp_11_028 | 2011 | Politecnico di Milano | Anni Marta | Scuola Primaria Statale "A. Moro" | Scuola Primaria | Lombardia | PoliCultura | |
| 4 | Exp_11_015 | 2012 | Politecnico di Milano | Ciapponi Graziella | Scuola Primaria Francesco Saverio Quadrio - 1^ Circolo Didattico, Sondrio (SO) | Scuola Primaria | Lombardia | Techology@School_TV | |
| 5 | Exp_11_030 | 2011 | Politecnico di Milano | Aicardi Daniela | I.I.S.S. "Giancardi-Galilei-Aicardi" | Scuola Secondaria di II grado | Liguria | PoliCultura | |
| 6 | Exp_11_023 | 2012 | Politecnico di Milano | Mariangela Menghini | Istituto di istruzione secondaria di I grado "Bernardino di Betto", Perugia (PG) | Scuola Secondaria di I grado | Umbria | Altro | |
| 7 | Exp_11_021 | 2012 | Politecnico di Milano | Nastasi Santino | Liceo Classico Statale "Chiabrera", Savona (SV) | Scuola Secondaria di II grado | Liguria | Altro | |

Fig. 3 - A screenshot of the experience list view in the internal interface of the repository

In order to evaluate the L4ALL external repository, focus groups were organized as a way to investigate issues not fully known. Three focus groups were held in autumn 2012 and, on the whole, 32 users were involved whose average age was 42. The three focus groups adopted a similar procedure: the moderator gave a general introduction to the repository and the goal of the study. Then, the helper showed some of the repository's affordances and finally the participants were divided into small groups of three users each. Each group had tasks to perform such as publishing documents on the repository and carrying out the tagging procedure. During task performance, the focus group moderator and the helper would monitor what was going on within the groups but without interfering and, at the end of these activities, all the participants re-grouped again for the final discussion, prompted by the moderator's questions. The outcome of the focus groups was highly encouraging. In fact it was emerged that after the initial difficulty of the apparent complexity of the interface, users became comfortable with it. Overall, they said that after a few minutes of usage, the interface became quite usable.

Data model validation activities demonstrated how the experience data model has been fully instantiated and provided by the internal repository prototype. Fig. 4 shows a screenshot (localized in Italian language) of the Exp_11_100 experience page in the internal interface. It contains four main sections: (i) the concise data about the experience; (ii) the interviews' list, containing (in this case) the expectations and results interviews; (iii) the materials list, at a glance; (iv) the attachments list.

The experience material can be fully downloaded (for example by tagging experts) in zip format by clicking on the "Scarica experience" ("Download experience") button. In Fig. 5, the first page of the Exp_11_100 experience FEE form is shown. This form is bilingual (Italian/English).

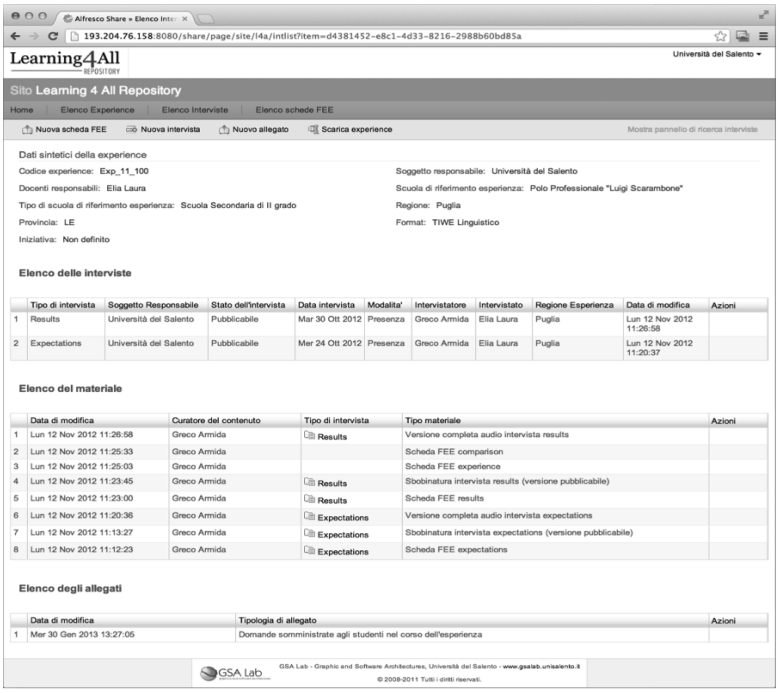
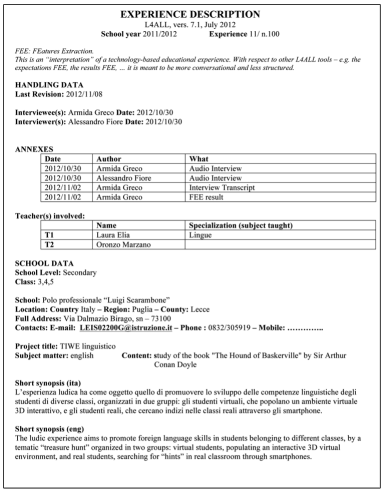



Fig. 4 - The Exp_11_100 experience page in the internal interface of the repository



**EXPERIENCE DESCRIPTION**

L4ALL, vers. 7.1, July 2012

**School year** 2011/2012 **Experience** 11/ n.100

*FEE: FEatures Extraction.*
*This is an "interpretation" of a technology-based educational experience. With respect to other L4ALL tools – e.g. the expectations FEE, the results FEE, ... it is meant to be more conversational and less structured.*

**HANDLING DATA**
**Last Revision:** 2012/11/08

**Interviewee(s):** Armida Greco **Date:** 2012/10/30
**Interviewer(s):** Alessandro Fiore **Date:** 2012/10/30

**ANNEXES**

| Date | Author | What |
|---|---|---|
| 2012/10/30 | Armida Greco | Audio Interview |
| 2012/10/30 | Alessandro Fiore | Audio Interview |
| 2012/11/02 | Armida Greco | Interview Transcript |
| 2012/11/02 | Armida Greco | FEE result |

**Teacher(s) involved:**

| | Name | Specialization (subject taught) |
|---|---|---|
| T1 | Laura Elia | Lingue |
| T2 | Oronzo Marzano | |

**SCHOOL DATA**
**School Level:** Secondary
**Class:** 3,4,5

**School:** Polo professionale "Luigi Scarambone"
**Location: Country** Italy – **Region:** Puglia – **County:** Lecce
**Full Address:** Via Dalmazio Birago, sn – 73100
**Contacts: E-mail:** LEIS02200G@istruzione.it – **Phone :** 0832/305919 – **Mobile:** ……..

**Project title:** TIWE linguistico
**Subject matter:** english **Content:** study of the book "The Hound of Baskerville" by Sir Arthur Conan Doyle

**Short synopsis (ita)**
L'esperienza ludica ha come oggetto quello di promuovere lo sviluppo delle competenze linguistiche degli studenti di diverse classi, organizzati in due gruppi: gli studenti virtuali, che popolano un ambiente virtuale 3D interattivo, e gli studenti reali, che cercano indizi nelle classi reali attraverso gli smartphone.

**Short synopsis (eng)**
The ludic experience aims to promote foreign language skills in students belonging to different classes, by a tematic "treasure hunt" organized in two groups: virtual students, populating an interactive 3D virtual environment, and real students, searching for "hints" in real classroom through smartphones.

Fig. 5 - An extract of an experience FEE form.

Trying to evaluate how the internal repository interface helped partners in

collecting and sharing educational experiences (process evaluation), significant measures have been extracted both from Alfresco Share and from the Alfresco access logs.

We notice that the average actual time to load an experience consists of about 11 minutes despite the complexity of the experience object (which includes the data entry of different metadata beside the materials upload). The average elapsed time to load an experience, which also takes in account the time of inactivity while loading the experiences, is significantly higher than the former (2 hours, around 10 times higher), so it can be argued that the partners are used to carry on multiple activities during the experiences loading. The average time spent by a partner during a connection session to the repository is 3 minutes higher that the actual time; that is because during a session the partners also navigate the repository for analyzing the experiences loaded by other partners (for example to take them as a reference). We also computed an average learning curve as the mean of the learning curves for each partner. On the x-axis we have the experiences sorted by creation date (grouped by partner); on the y-axis we have the time in minutes. The curve is shaped as a decreasing exponential function; the learning curve pendency variation for the first 2 steps is around 60% (i.e. the user need 60% less time for loading an experience at each step), then 25% for the 3rd step, finally around 0% for the remaining experiences. So it can be deduced that partners have learned to use proficiently the repository internal interface after about 3 experiences loaded, and they become fully productive.

We extracted some significant measures about the use of the repository. The 7 L4ALL partners produced 286 educational experiences, 1424 materials, 763 FEE forms, 363 interviews. 286 teachers from 255 schools (25 kindergarten schools, 69 primary schools, 77 middle schools, 84 high schools) implemented 17 technology-based educational formats.

## Conclusion

The focus of the presented research is on the models and techniques behind a repository of high quality technology-based educational case studies. Through this lens, we have developed and experimented a collaboration framework adopting coherent and coordinated approaches for the capture, identification, storage and retrieval of educational intellectual assets for efficient use of existing knowledge. We have collected empirical evidences of 286 educational experiences via a large-scale project (L4ALL). Instancing and maintaining a repository of innovative educational experiences – actually carried on by real teachers, in real-life situations – led us to face and overcome a set of challenges: (i) defining an organizational model to support the collection of evidences from

hundreds of experiences, taking into account feasibility and cost considerations; (ii) describing each case study by a rigorous but flexible data model, able to provide crucial information such as goals, implementation, benefits, and context, while supporting a wide range of educational materials; (iii) supporting the dynamic evolution of the processes behind the case studies capturing.

At the time of writing, our experience base is composed of 286 educational experiences. A great collaboration effort has been spent among the L4ALL partners. The L4ALL consortium has adopted a robust and consolidated collaboration framework, which has been described in this paper, as well as the data model behind any educational experience.

Future work will concern the fulfilment of the repository with more and more (thousands) potentially reusable educational experiences and the opening of the repository to external (international) contributors.

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