Active E-Learning by Doing with ALDO[1]

(Discussion Paper)

Ilaria Bartolini[1], Andrea Di Luzio[1]

[1]*Department of Computer Science and Engineering (DISI), Alma Mater Studiorum, University of Bologna, Italy*

Abstract
It has been proved how teaching and learning educational processes can largely benefit from the application of ICT-based services within e-learning platforms, such as collaborative editing and advanced data visualizations. However, among state-of-the-art solutions, no one is able to tackle the problem in a comprehensive way. In this extended abstract, we discuss ALDO (Active e-Learning by DOing), a novel, advanced digital framework supporting integrated facilities for effective, active e-learning. ALDO includes an active repository for collecting, sharing, retrieving, and analyzing relevant materials, collaborative editing services, an e-learning platform, and advanced visualization tools to inspect the spatial and temporal dimension of specific data contexts. All such services and tools are made available to teachers/students through a dedicated Web portal. Although the present research was carried out within the H2020 Project DETECt (Detecting Transcultural Identity in European Popular Crime Narratives), by focusing on the specific data context of European crime narrative, the generality of the framework makes it suitable for any type of educational task. The design and creation of above tools and services, together with their uses, are presented and discussed through a series of real examples taken from DETECt.

Keywords
E-learning, Web services architecture, data management, data visualization

1. Introduction

Thanks to the success of ICT and the resulting explosion of the digital transformation, we are currently assisting in the rapid deployment of web-based services that enable collaborations and interactions between users from any type of organization and from very far locations. When considering the educational and academic contexts, remote interactions/collaborations are commonly implemented by schools and universities through the adoption of collaborative editing systems and e-learning platforms [7, 10]. More specifically, several studies have confirmed the benefits of using collaborative writing [7, 10, 11] and e-learning platforms [6, 2] in teaching. It has been proven that greater benefits in teaching and learning processes can be achieved by including multimedia digital materials within e-learning courses [1]; this also promotes students inclusion with respect to the possibility to attend frontal lectures, by overcoming geographical limits and economic barriers [9]. This opportunity was further confirmed during the recent pandemic. Any attempt to produce a "complete" e-learning platform should therefore consider

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collaborative editing of learning materials and ICT-based facilities as a "must" of the services to be offered.

DETECt (Detecting Transcultural Identity in European Popular Crime Narratives) is a multidisciplinary project that addresses the problem of identifying a European intercultural identity starting from the analysis of popular crime fictions (i.e., criminal narratives, films, and TV series).[1] This to demonstrate that popular culture is a powerful resource to connect European citizens and foster their reciprocal understanding. Within this context, we conceived ALDO (Active e-Learning by DOing) a multi-functional digital infrastructure which allows "anyone" access to diversified digital resources together with advanced tools and services for the integration of research and learning activities in formal and informal educational contexts [4]. This digital infrastructure is made up of the back-end where data collection, sharing, curation, and analysis take place (within the active repository) and the front-end which includes a collaborative atlas, a case studies section, and a learning community. Although specifically designed for DETECt, ALDO's generality makes it the perfect solution for any educational activity in a single integrated platform.
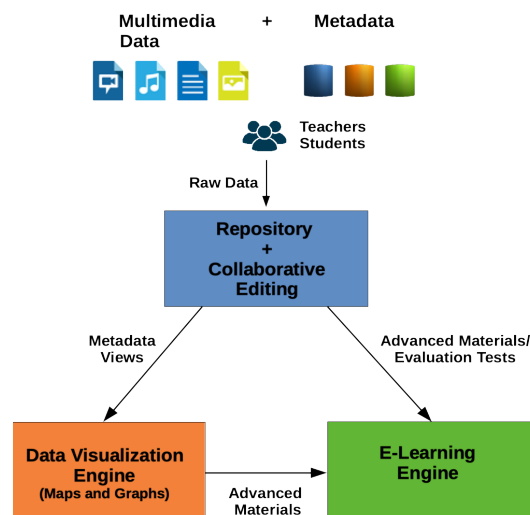

Figure 1: Active e-learning exploiting ALDO framework.

Figure 1 shows how reaching effective, active e-learning is feasible with ALDO. In our view, teachers and students can use the repository to collect multimedia materials and metadata. Using the tools provided by our collaborative editing/repository platform, teachers can work together to create advanced teaching materials based on the "raw" data uploaded. Moreover, through appropriate selections ("views") of the collected data and metadata it is possible to create advanced visual displays, through interactive maps, graphs, and timelines. Such advanced materials (i.e., teaching materials, maps and graphs) can therefore be used within the e-learning platform to enrich the resources made available to students within the individual courses. Similarly, students can create their own materials in the repository (by building new documents

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[1]H2020 DETECt project (2018-2021): https://www.detect-project.eu

or working on the basis of the resources already present in the e-learning platform), working alone or collaborating in groups, and then uploading their evaluation tests to the courses attended in order to obtain an assessment by the teacher. To the best of our knowledge, ALDO represents the first attempt to closely integrate all described services and tools into a single reference digital platform.

The rest of the paper is as follows: Section 2 introduces the related work; Section 3 describes ALDO by detailing the underlying software architecture and the design and creation of provided tools and services; Section 4 concludes the manuscript.

2. Related Work

Due to the absence in literature of complete digital infrastructures able to support teachers and students in all above described e-learning features and services, our study focuses on individual reference-based educational solutions, by paying particular attention to the possibility to develop customized implementations of the related technologies. Concerning e-learning platforms, Moodle[2] was found to be one of the most used [3] open source Learning System Management (LSM) and also one of the best evaluated [6, 8]. For these reasons, it was quite natural for us to include Moodle technology in the design of ALDO. As regards cloud platforms able to offer documents storage tools and update data services through collaborative writing, it has emerged that Google Docs, in combination with Google Drive, is widely used in the field of education with documented benefits in terms of both student productivity and student involvement [7, 10, 11]. However, since it is not possible to develop customized implementation of Google Docs, for our purposes we had to refer to an open-source alternative to Google Drive and Google Docs, as we will detail in the next section. In addition to this limitation, both Moodle and Google Drive do not effectively support the possibility to manage traditional metadata information.

Table 1
E-learning features/services: a comparative analysis.

	Moodle	Google Drive + Docs	ALDO digital framework
E-learning	Yes	No	Yes
Data + Metadata Repository	Partially	Partially	Yes
Collaborative Editing	No	Yes	Yes
Interactive Data Visualization	No	No	Yes
Open Source Software	Yes	No	Yes

Table 1 expresses a comparative analysis of the literature in terms of e-learning features/services. As it is possible to observe, the peculiarity of ALDO consists in being able to effectively and

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[2]https://moodle.org

efficiently provide all needed services and features that are normally provided individually by state-of-the-art platforms.

3. ALDO Digital Framework at Work

ALDO digital framework is made by a software architecture (back-end) and a set of services and tools integrated in the dedicated Web portal (front-end), as depicted in Figure 2.

In the following, we illustrate their design, creation, and uses to demonstrate how they can facilitate teaching and learning activities in any context of use.[3]
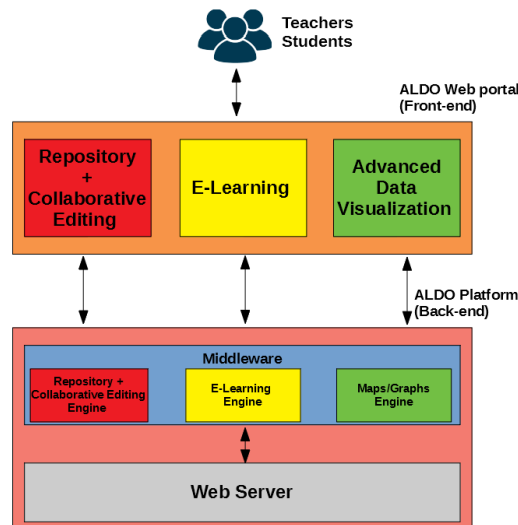
Figure 2: ALDO software architecture.

3.1. Software Architecture

In setting the best software architecture for ALDO, we have assumed the use of free and/or open source software as a fundamental requirement. The harmonious integration of the many, different customized software libraries included in the ALDO software architecture (see Figure 2) is carried out within a dedicated, additional "middleware" software layer. More in details, the persistence of the collected multimedia materials and metadata is managed by an active repository based on database technologies. All comments, tags, annotations, uploaded files, and conversations are stored in the repository that maintains different type of data like "raw" multimedia data, qualitative descriptions (i.e., metadata like the title of a series, the author, the description, etc.) and quantitative descriptions (e.g., annotations, comments provided by teachers/students).

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[3]We invite the reader to experience ALDO first hand at: https://www.detect-project.eu/portal

Within the active repository, users can search by metadata, by keyword and tag, or simply navigate the multimedia material exploiting a visual browsing tool providing users the means to interact with any data of interest (audio, video, textual documents, PowerPoint, etc). In this regards, DETECt emphasizes the collaborative actions that allow users to discuss, interact and prepare advanced learning material for modules and courses.

Since ALDO Web portal acts as a showcase for all the services and tools made available to teachers, students, and public users, the choice of its reference structure has been virtually forced. ALDO Web portal is divided into public sections and private sections with restricted access.

Restricted access sections include the e-learning and collaborative editing platforms. The learning community includes a Moodle through which teachers can create their own course by keeping and utilizing the material from the repository. The sections with public access are case studies and those related to maps and graphs (i.e., the Atlas) used to offer advanced views of the multimedia materials and metadata of specific contexts. The Atlas is an interactive dynamic multi-layer navigational tool offering the user the capability to search for information and explore temporal-spatial dimensions of data in specific contexts of interest through interactive maps and graphs that are completely synchronized with the data from the repository. The user can even access case studies through the Atlas by their location. Users can browse by region and find something of interest in this way. The case study section offers an overview of research about significant fictional worlds. Here the entries are a mix of textual description, videos, and links which take you to other relevant portions of the Web portal.

3.2. Repository and Collaborative Editing

Collaborative editing is a process of writing documents that involves multiple people and is aimed at producing a work through individual contributions. The use of collaborative writing tools can offer substantial benefits to any activity, ranging from increasing user engagement to simpler work processes.

However, designing and implementing a graphical user interface for an online active repository enabling collaborative editing is not a trivial task. The first step towards this goal is to identify all the characteristics that a collaborative system must guarantee in terms of provided services. Among such features, a collaborative environment has to be able to arrange users in groups, limit users' privileges by assigning them different roles or reducing their permissions in accessing documents, offer each user the ability to collect or create documents, perform reviews, validate the work of contributors (through synchronous and asynchronous communication), and make specific annotations and/or comments to documents. Finally, a collaborative system must provide an automatic versioning system that keeps track of all document changes: this allows users to keep the history of the changes made and provides the possibility to retrieve them, starting from a previous activity.

Two open source software platforms have been exploited to join above goals withing ALDO repository: Nextcloud[4], for the development of the online file system functionalities, and Libre-Office Online[5], for the implementation of the collaborative editing services. The two platforms

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[4]https://nextcloud.com
[5]https://www.libreoffice.org/download/libreoffice-online

have been opportunely customized with the final result of a novel, modern collaborative platform that is simple and intuitive to use and that meets all above requirements.

The first, basic functionality offered by the ALDO digital framework is represented by the possibility for the users to collect/analyze multimedia materials and perform the classical actions of deleting, copying/moving, and downloading uploaded files. In addition, users have the possibility to take advantage of a preview of the files, by directly inspecting the file content or the related details (i.e., the file size, the creation date, etc.). This function is particularly useful for examining the contents of a file without having to download it. Moreover, users can add to "favorites" the files they work on more often so they can view them all through with a single click on the dedicated menu item. Further, it is possible to access to the various activities done on each file, the comments inserted, the sharing activities and, above all, the different versions of the file. We remind that this last feature is an indispensable service for a collaborative editing tool. Finally, the interface provides a tagging field where the users can insert tags and/or view the tags associated to each file. The great advantage of providing the users with a tagging service is that, once the users have tagged documents, the tags can be profitably exploited for searching purposes: users can search for documents of interest by entering specific tags in the dedicated "search bar". This represents a fast and convenient direct access to the repository materials.

As further functionality, if the structure of the folders is based on an ontological modeling of semantic concepts relevant to a case of study, users can also add metadata concerning concepts or individual files simply by inserting an excel file in one of the intermediate folders (i.e., metadata concerning concepts) or in the folder where the multimedia files are present (i.e., metadata concerning the individual files). The import of metadata within the database is automatic; this operation enables the search for files and folders through the metadata search interface. Through this interface, it is possible to view all the information concerning a specific concept as well as all the multimedia files associated to it. In addition, thanks to the customization of LibreOffice Online platform, the users can edit, directly from the Web browser, text files, spreadsheets and power point presentations contained in the repository.

3.3. E-Learning Platform

This section exposes the rationale for choosing Moodle as reference technology to build the ALDO e-learning platform, and how the tool has been implemented to respond to the needs of teachers involved in the project activities.

Our design choice assumed that users (i.e., scholars and teachers) were already regular users of the Moode platform (made available by their universities). In this context, to facilitate the creation of their content, we have decided to deliver a quite standard implementation of the Moodle focusing more on offering an easy-to-use Web interface and, above all, a tight integration with our collaborative editing platform. This ensures to make easy and comfortable the sharing of teaching materials, created and stored in the collaborative repository, to students. In fact, ALDO e-learning platform provides the teachers (under appropriate verification of credentials) the possibility to load resources into courses picking them directly from the repository.

In details, a teacher can create the materials in three different ways: (i) activities, (ii) resources and (iii) blocks. An activity is a tool through which students learn by interacting with each other

or with the teacher, thus presupposing the active participation of the student. Some examples of activities, among the others, are glossary (that allows participants to create and manage lists of items, such as a dictionary or a collection of resources and information) and crosswords (a gamification tool that allows students to memorize the terms of the glossary by means of crosswords based on its definitions). A resource, instead, is an element that a teacher can add to the course to support learning, unlike activities they do not presuppose active participation between teacher and student: the student simply looks, reads and studies what is present in the resources. An example of resource are files inserted by the teachers within a course. Finally, a block is an element that the teacher usually adds to the sides of the course page and provides additional information or useful tools to facilitate learning. Some of the most common blocks are calendar (that shows course events, like deadlines for activities included in the course) and a text box that displays the description of the course.

3.4. Advanced Data Visualization

The basic reason to support the automatic generation of advanced data visualizations is to provide users with data inspecting tools, like interactive maps, graphs, and timelines, able to explore the spatial and temporal dimensions of specific data contexts. This is possible through specific multimedia data analysis and/or metadata aggregations from the repository able to define views of interest for the users [5]. Such views allow the emergence of peculiar data characteristics and the possibility to navigate them at different levels of granularity. The interactive resources will allow students to generate their own corpora to be examined from quantitative and qualitative perspectives. They will be invited, for example, to examine research questions based on these materials: the questions might be prepared by the teacher but they might also be developed by the students through the observation of the visualizations. Students will be asked to answer these questions by conducting independent research, using resources included in the portal but also, and primarily, by researching other relevant sources.

We have equipped our data with geographic references so that to be able to derive two different types of visualization interfaces: maps, through Leaflet[6], and graphs, exploiting Highcharts.[7] In our implementation of Leaflet we focused on the most typical use of the technology: inserting a map into a Web page, mapping geo-referenced data (metadata plus related multimedia resources, all persistently residing in the active repository), and adding other elements such as markers and popups. In fact, using Leaflet, metadata and multimedia resources associated to each data entry can be arranged on the map and displayed through markers.

Since Leaflet allows the display of more resources/metadata for the same location, it is also possible to have a preview in the tool-tip of different data type like videos, audios and images. Since all the platforms that are part of our digital framework are deeply integrated with each other, it is also possible to maintain the reserved access to files displayed in the map by inserting, instead of the preview, a link that goes directly to the relative folder in the repository, so that only users with credentials and display rights for that files can access them. As for the automatic generation of graphs, we have chosen to use the Highcharts library for this specific task because it is the leading open source software for the generation of graphs/timelines.

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[6]https://leafletjs.com
[7]https://www.highcharts.com

4. Conclusions

In this extended abstract, we discussed a novel, advanced digital framework for active e-learning called ALDO. ALDO represents a complete, integrated solution for the effective collection, sharing, retrieval and smart analysis of domain-specific's multimedia data, together with advanced online collaborative tools and interactive data visualizations made available to users through the dedicated Web portal. An integrated e-learning platform is also provided to facilitate transnational teaching and learning activities in any context of use. Since its launch in 2019, ALDO has been fully operational: it has been used by many partners in the 18-member DETECt consortium to deliver their institutional courses, including, and especially, during the pandemic period.

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