

Ubiquitous Learning Perspectives in a Learning Management System

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Abstract. The DULP vision is providing an innovative perspective for rethinking learning processes, to become, among the others, ubiquitous and focused on persons in their daily activities, according to the new dynamic reality that we face every day. The challenge we present in this work is to bring the DIEL system further into exploring DULP implication, with a specific effort on mobile learning and in the exploration of the meanings of quantitative data collection as indicators of learning process trends.

Keywords: ubiquitous learning, quantitative data analysis

1 Introduction

The increasing importance of the role of technologies in our lives is affecting all common activities. Especially advanced and multi-purpose mobile devices represent one of the most visible novelty. Nowadays, for example, it is usual for everyone to carry a smart-phone, generally connected to the Internet, that we use not only for professional reasons, but also for entertainment purposes. As a consequence, social network websites have gained popularity, allowing users to upload content, pictures and more, so to communicate news, emotions, ideas, directly and in real time, to the world. The DULP vision, taking into account these considerations, is providing an important and innovative perspective for rethinking learning processes, to become ubiquitous, according to the new reality that we face every day.

DIEL[1] is a platform (LMS, learning management system) that allows the creation of a virtual environment, and encouraging the creation of distance learning communities. It provides an effective support for designing learning paths directly transposed into the virtual environment. The experience that we present in the paper is to enhance DIEL into exploring DULP possibilities, with a specific effort on mobile learning and in the exploration of the meanings of quantitative data collection as indicators of learning process trends. Especially the latter could become crucial, as DULP involves the definition of new learning strategies and methodologies, that need

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to be evaluated in settings and situations that are non-traditional, like for example a nomadic setting, typical of ubiquitous learning experiences.

2 The DIEL System

DIEL is an e-learning platform developed for providing new ways of user interactivity and data representation in a web-based real-time environment. More precisely, DIEL is a project that aims at creating a dynamic and interaction-friendly graphical interface, a *virtual learning space*, for community portals. DIEL is at present implemented by extending the popular open source portal Moodle[2].

The goal of DIEL is not only to implement a technical infrastructure, but to verify its effectiveness in terms of value and improvement given to educational activities.

The possibility of conducting social-interactive tasks allows a learning community to adopt social-constructivistic approaches: group activities that require intense interactions can happen (be they formally structured or not), through the use of the social translucence concept[3]. The social translucence principle primarily states that if all members of a web community could be aware of what every other member is doing, the whole community would modify its dynamics accordingly, as for real life interactions.

The paradigmatic example is very simple but effective: if one person is opening a door, knowing that on the other side another person is going to do the same, she would open it carefully.

Probably, if she had not this information, the door would be opened in a different way, risking to hurt the person who is on the other side.

The social translucence principle applied to this example would mean to design a door with a window, in order to allow to see on the other side.

DIEL is applying the social translucence principle, letting the learning community be aware of every activity held by every member; if a student accesses a resource, her avatar will be displayed close to it. This allows members to group, to discuss or to study together, in a structured way or not.

In the DIEL virtual environment, individuals are free to move and interact, find contents and insert opinions, without a fixed interaction stereotype. The organization of a learning activity inside DIEL becomes much like the exploration of a virtual set of *rooms*, each of them dedicated to a specific learning activity.

Moodle resources appear as objects inside the room, and moving from room to room is achieved by traversing doors. When planning a learning path for the class, the teacher naturally maps course contents and activities into a corresponding path which traverses interconnected rooms.

Number, purpose and content of each room are defined by the teacher, while the learners are let free to explore them.

In short, DIEL courses are represents as rooms which are connected together with a teacher-definable topology. Its main components are:

- *rooms*, which describe the virtual learning space,
- *doors*, which connect two different rooms,
- *users*, which can be either students or teachers, interacting in the environment and using
- *resources*, that is, any source that a user can inspect inside a room.

Examples of resources are forums, wiki, textual or audio-video chats, and assignments.

Currently, a DIEL user is represented in the environment as a 2D avatar (see Fig. 1) that is able to move around in the learning space (a set of virtual rooms) and that has the ability to interact in real-time with other online users and with available resources.

DIEL also provides a 3D interface, that communicates with the same server-side components and provides (at present) the same functionality offered by 2D visualization. The authors are however considering new specific features that can exploit the 3D environment, for instance supporting a personal user space that contains user-selected contents, seamlessly integrated with the standard course view.

DIEL comprises an audio-video chat system as well as presence awareness functionality; it supports collaborative resources like wiki and forum, powered by Moodle. The set of DIEL specific Moodle extensions include a GUI where actions of other participants are immediately visible, complemented by new interaction features. For example a one-to-one chat may be opened when two users are close, inside the virtual environment, to one particular Moodle resource, so to discuss about that particular resource that is interesting for both.

3 The PLE Hexagon Model

Even if it is generally acknowledged that quantitative parameters could not be used in a comparative evaluation of the experiences of users, our effort in this sense aims at defining a representation that is convenient for the teacher for the collected data.

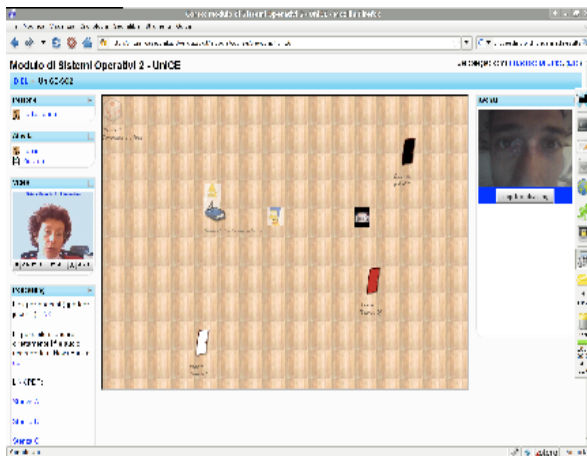


Fig. 1. The DIEL 2D interface

This means that the teacher could use the data, organized in a set of indicators and aggregated throughout a number of criteria, in order to obtain an insight on how a certain student interacted with the community, as it is customary from Moodle already. In fact, since Moodle already features collections of quantitative data, that describe the way users interact with each other, and with the system, it is straightforward to extend such data collections to all kinds of interaction that DIEL supports.

The novelty represented by the additions may also serve to highlight different perspectives that go beyond the pure tracing and assessment of student contributions. For instance, by tracing how many interactions took place around a given resource, the teacher receives a feedback on the amount of interest the resource itself has raised, possibly complemented by a qualitative assessment about its content (did students spend a lot of time because it was interesting? Or because it was obscure?) In this way the teacher, especially in blended and in on-line teaching, where other kinds of feedbacks are not available from students (no stunned eyes, no yawns...) could nevertheless obtain a set of information, which he/she may use to improve the course and the learning experience (Should additional material on such topic be made available? or is it enough?).

The DIEL additional instrumentation comprises:

- tracking for avatar movements in the virtual environment;
- information about the opening of audio/video/textual chat sessions, one-to-one or public;
- collecting all the contributions that a user produced within a community.

All the mentioned enhancements have been implemented but their thorough evaluation is still ongoing, and shall not be part of this paper. However, preliminary results are available for tracking of avatar movements, and are presented in the rest of this section.

3.1 Experiences

One of the experiences conducted involved about 25 high school students enrolled in a technology-focused study plan. They have been provided with a DIEL setting, arranged to propose them a “Treasure Hunt”. This setting was composed by a set of rooms, each of them containing a number of doors; users needed to choose the right alternative, according to the hints that were contained in room's resources. This experience has been designed following an analogy with simpler learning processes, where students acquire new information (a learning objective) at the end of an experience. In our case, finding a solution for a number of quizzes that composed a thriller novel, students could obtain access to the “treasure”, i.e., the murderer's name. The DIEL setting is shown in Fig. 2.

The data collection taken into account is relative to a specific room, that contained one of the quizzes of the experience. The room layout is shown in Fig. 3: it contains a set of 12 hints in the upper part, that allowed to choose the right answer to the question proposed in the resource indicated with an “I”, located just above the 5 doors that represented the possible answers.

The optimal position sequence is composed by 14 locations: the quiz (the “I”), a visit to the 12 hints, and the final choice. In Fig. 4, the movements of 4 users are considered, and represented in a graphical layout. Each user is associated to a color, that is used to draw the trajectory formed by the ordered sequence of user positions. In the box visible in the top part of the figure, each agglomeration represents the location of resources, as they are visible in the top part of Fig. 3. All users eventually chose the right door, i.e., the appropriate solution, which is underlined with the circle in the bottom left corner. The number of clicks required varied from 15 to about 30. Two students chose also a wrong answer (the cycle in the lower-right part).

Tutors may wonder why some students required a higher number of clicks with respect to the others: didn't they focus well on the task? Yet the task was actually simple. In this case, however, the main explanation could as well be that users were not sufficiently acquainted with DIEL, thus the novelty of the graphical representation could have distracted them from the educational goal.

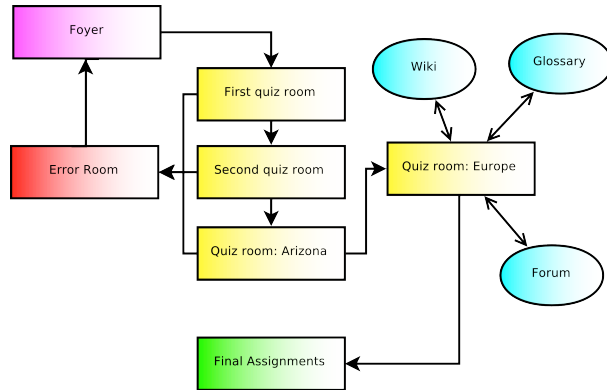


Fig. 2. DIEL setting for treasure hunt experience

Another quantitative information of interest is to consider which users visited all the resources present in the DIEL room. While a proper assessment remains the privileged method for estimating student's learning progress, this information can provide the tutor an indication of how much a user interacted with course resources. Similarly, it is possible to track the interaction level of a user with other users in a course, simply checking how many interactions (e.g., chats, file transfers) she was involved into.

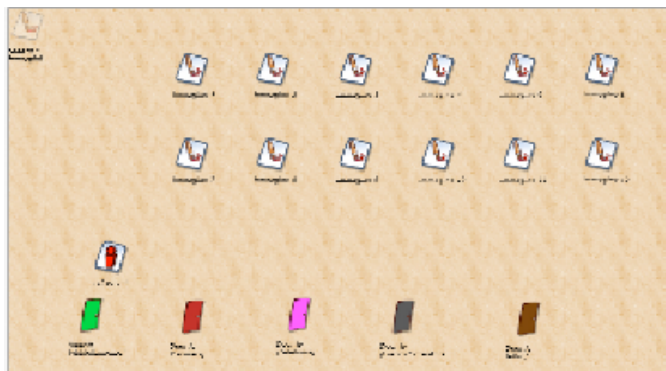


Fig. 3. A room in the Treasure Hunt experience. The layout contains a set of resources and doors.

Fig. 5 shows movements of two users, this time taking into account the temporal order of their movements (on the vertical axis).

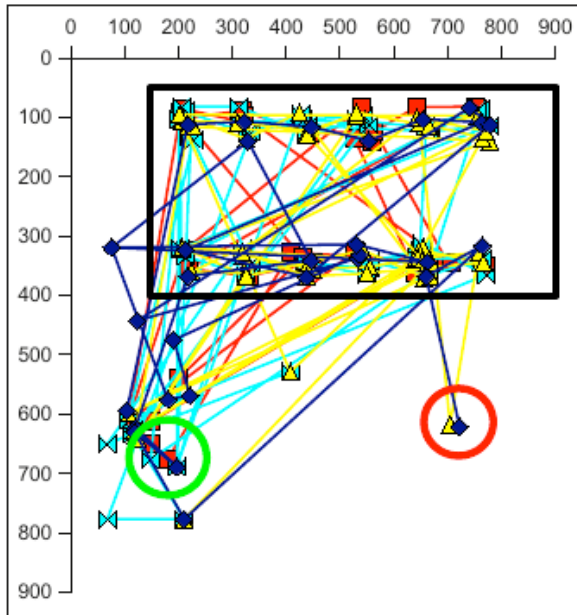


Fig. 4. A room in the Treasure Hunt experience. In the upper part, the different positions of users in a room, while circles indicate higher concentrations of users.

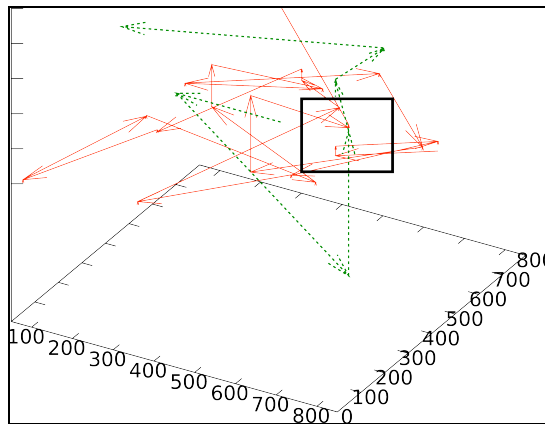


Fig. 5. Interaction of users in DIEL. At the same time (in the black box), two users (dotted and straight lines) were located in the same position

Given suitable threshold for time intervals and avatar positions, (in this case, 2 seconds and a square area of 40 pixels), we notice that in the circle, both users were present in the same place at the same time. Then, we may check what kind of interaction they had, according to server logs.

The above analysis is just preliminary, as we are still exploring the possibilities provided by spatial data collection from virtual space exploration. Our goal is to produce a report for each student, that would present a list of indications about her movements, similar to the ones expressed here.

4 DIEL Mobile Learning

Mobile Learning (generally referred as m-learning) can be seen as a valuable complement of a learning strategy, that aims at being ergonomic to the needs of users. The use of mobile devices, especially using podcasts and/or methods to allow users to download content, has been analyzed in a number of experiences ([4-7]). It is relatively new to consider m-learning in terms of a bidirectional channel that binds a user to its community. Other valuable experiences conducted with mobile devices and software, centered on coordinating the efforts of a learning community (see for instance [8], [9]), generally do not focus on providing an effective mobile support for cooperative tasks.

The DULP paradigm clearly affirms the centrality of persons as key actors of the learning process. The concept of ubiquitous learning can be explained as a tendency to provide a person with tools and solutions for following an educational process, that could join her in her daily activities. It can be seen as an extension of m-learning, using a holistic definition that comprises more specific educational requirements. In spite of this, in our view technology (and especially mobile solutions) is expected to become “transparent” (like in [10]), absolutely a metaphorical vessel for knowledge and a mean of interaction with a learning community. This statement is the origin of a number of challenges, both for educational and technical aspects. The former are related to specific strategies and methodologies, that could cope well with space and time limitations, typical of a mobile context. On the other hand, despite the always-improving performances and functionality offered by mobile phones, some technical and functional problems interfere with the proposed goals, for instance in terms of convenience in content creation, connectivity access, technical barriers due to mobile operating systems design to ensure security and reliability. Moreover, in several parts of the world, the availability of the latest mobile devices, as well as Internet connectivity, could represent a serious issue, and an additional requirement hard to be fulfilled.

The challenge that we undertook is to enable persons using a mobile device to interact in almost the same ways they are used to, when logged on a PC system. Our goal is to exploit intrinsic features of mobility systems, in terms of ergonomics and ease of use, to let the users collaborate on a given topic.

As previously mentioned, when designing a mobile service, we should remember that actual availability of services is far from optimal in several settings, from third-world countries to mountain areas, and often also for commuters, not to mention the possible costs incurred for huge mobile data transfers. Students, for example, may wish to do uploads and downloads when it is fast and for free, namely at home or at their school or university. Conversely, data transfers on the move should be avoided since they risk be slow and expensive.

Content creation should be possible anywhere, and the system should encourage it (e.g., taking a picture while going outside, then adding it to the shared information of the community). In short, the entire operation of the LMS should be compatible with

new usage patterns, namely disconnected activity on replicated contents, followed by later synchronization of replicas when the mobile user is again connected.

The collaborative services that we implemented permit the users to share the content they generate, through a dedicated service (mobile learning management system, MLMS) that manages content approval, distribution and versioning. A community may need a tutor to enable a moderation policy; in that case, any content that is submitted to the community must pass a review process. Once the approval is granted, the MLMS will notify every mobile client that a new content, or a new version of a content, is available. Text could be created by a user, modified and approved by the moderator, and later improved with more statements and multimedia by the rest of the community. The initial set of operations available (creation, publishing, modification, approval of contents) is nevertheless sufficient to support an initial support for the most common activities in any cooperative learning settings.

A specific mobile application is under development, and it reached its beta version. We are now involving users, in order to collect their impressions and assess its interface before developing the first release. In particular, the MLMS service is currently able to be inquired through the mobile application, in order to create a local cache of content. At the end of the implementation, it will be possible to a) download content, edit or create it from scratch on a mobile device; b) to upload content only when desired, i.e., when a WiFi connection is available; c) to be notified when a new content is available after being approved.

The advanced features that we are implementing require the use of a dedicated client, especially for the management of a local (versioned) cache of contents, and to receive automatic notifications for new elements to download. Our implementation enriched an advanced interface (provided by the MLE project, [11]) that already provides a set of useful features, in particular an interesting human-computer interface. The application is rendered in the same way on almost any mobile device that supports Java software. This way the MLMS is not bound to just a few high-end mobile devices, but is available on most modern mobile phones, including cheaper ones.

4.1 MLMS Mobile Client

In order to support an easy method for content creation and management, we implemented a mobile wiki interface, which is shown in Fig.6.

Here, text editing is done in box number "2". A convenient command toolbar (in box "1"), allows to insert formatting markups as well as pictures and images. A simple HTML browser interface allows to render the properly formatted HTML page generated according the previously specified wiki directives.

There is another important feature provided by our mobile client, the caching mechanism. It enables users to create and manipulate contents, without requiring a wireless connection to be established. The contents are stored in a specific area of cell phones, and are synchronized server-side on user requests.

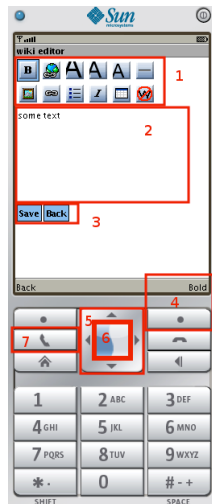


Fig. 6. MLMS Mobile client

4.2 MLMS Mobile Server

Our mobile client requires a server counterpart, that is demanded to adapt the format of contents going in both directions between them. More importantly, the MLMS server component (embedded in Moodle) enables the management and the propagation of contents. In fact, once a content (in general, a wiki page) is created or edited with a cell phone, it is then submitted to the server, that manipulates and stores it in Moodle (see Fig. 7). Immediately after, a notification message is added to the message queue, and it will be received by the other community participants as soon as they connect to the system (see Fig. 8). Then, each user could retrieve the new content, modify and then resubmit it with the same procedure.

For communities that require a moderator or a tutor, it is possible to activate a modification to the previously described work flow, to permit an easy content moderation. Just after receiving a new or a different version of a contribution, the server component will send a notification to the moderator, that will decide if the content shall be propagated or not.

The MLMS server is also responsible for updating the quantitative data collection, namely point c) in previously mentioned Section 3. The reason for this choice is essentially to evaluate the effectiveness of the new mobile interaction schema proposed, both from an educational and technical perspective: in fact, it shall be possible to evaluate the possible different participation levels of persons, comparing working sessions on PC and on mobile phones, for instance. This could be helpful in order to adapt strategies and methodologies that ensembles both session types, for instance.

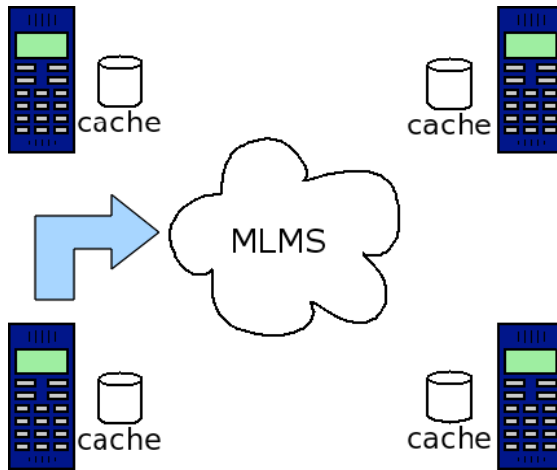


Fig. 7. MLMS content submission

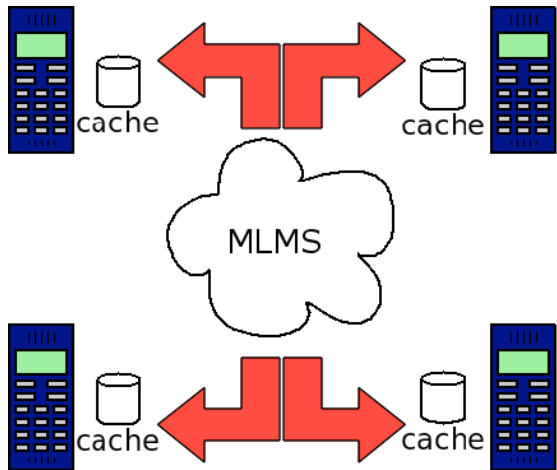


Fig. 8. MLMS content distribution

5 Conclusion

The DULP paradigm pushes us to consider and to assist the educational needs of persons in the different phases of their lives. As modern first-world society is evolving towards an “always-on” tendency, with respect to powerful mobile devices and flat-rate internet connection, education has to adapt to the modified scenario, with so called “ubiquitous learning”. On the other hand, the availability of less advanced but indeed useful mobile devices is increasing also in less developed parts of the world, making ubiquitous learning an interesting perspective for countries where laptops are hardly affordable.

The grand challenge that DULP offers has to be addressed taking into account specific strategies, methodologies but also software tools. There is a need for tools that act simply as content and interaction vessels, thus being like “companions” for persons in their activities. Moreover, there is also a need of understanding how users interacts with software tools, in order to verify the hypothesis underneath the proposals for new strategies and methodologies. Even if qualitative evaluations will always be necessary, quantitative analysis could represent an interesting perspective to explore.

The DIEL project has decided to undertake the ubiquitous learning challenge, developing a data collection tool and an advanced mobile client.

The former allows to monitor a number of aspects of the DIEL infrastructure, collecting user movements in the virtual environment, and information about her interactions with other persons and resources. The aim is to find convenient aggregation functions, able to present a report to the person herself and to a teacher, regarding for instance participation levels and interaction frequency.

The latter is a mobile client, that provides, among other features, a mobile wiki interface, which is a convenient way to create well-formatted and structured contents, even with a simplified markup structure. It also provides a caching mechanism, that allows to submit newly created or modified contents even when mobile Internet connections are not available. Lastly, it is deputed to send notifications to users about new available contents, and to support content moderation and versioning.

The evaluation of the implemented tool is ongoing, but preliminary results, especially with respect to the quantitative data collection system, seem to be promising.

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