

# **Diplek: An open LMS that supports fast composition of educational services**

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## **ABSTRACT**

Modern ICT has evolved through the years and is now in position of delivering educational content to specific target groups in remote locations. Advanced E-learning techniques are now used not only for delivering content to high school and university students but can be used in life long training programs. Due to the target group most of these programmes have (i.e. career people with little time to spend, people of a certain age with reduced ICT skills, etc.) it is vital that organizations choose wisely among the many Learning Management Systems currently available. The purpose of this chapter is to describe and examine the features of such a platform. DIPLEK is a platform developed using service oriented architecture to enable easy access to educational content and activities for novice learners and instructors.

Keywords: learning management system, virtual learning environment, Collaborative Learning, monitoring, course management, distance learning, IT education, Learning Object Metadata

## **INTRODUCTION**

**A Virtual Learning Environment or Learning Management System (VLE or LMS)** is a software system or integrated platform that contains a series of services and tools to support a number of activities and course management procedures (Ho, Higson, Dey & Xu, 2009). Nowadays numerous LMS are available in the market; a few more, like Moodle, Sakai, Atutor, Claroline, etc., are under development by the open source community. Another category of Learning Systems is the **Learning Design** (Britain, 2004). This category includes systems like LAMS (Dalziel, 2003) and Coppercore (Vogten et al., 2007). Despite the many tools and services offered by the LMS, a number of limitations and disadvantages were reported from users and researchers:

- 1) The platform complexity and difficulty of use require the continuous IT support and hence require a high investment for instructors and training of supported learners (Mendling, Neumann, Pinterits & Simon, 2005). Due to this complexity these systems cannot be easily used by people involved in lifelong learning and training programs.
- 2) Low level of reusability and portability of the learning content due to the non-standardized way that the educational material is stored (O'Droma, Ganchev & McDonnell, 2003; Avgeriou, Koutoumanos, Retalis, & Papaspyrou, 2000)
- 3) Limited number of available tools and services for proper monitoring the learners' activities throughout the course duration. (Mazza & Dimitrova, 2007)
- 4) The dependence on web technologies most of the platforms have, obstruct the deployment of distance learning services to internet-less communities and institutions.
- 5) Most currently available platforms emphasize on technology that facilitates interaction among learners and instructors and neglect personalization of the learning environment (Cheung, Hui, Zhang & Yiu, 2003)

The purpose of this chapter is to describe the design and development of Diplek an open-source educational platform that uses to support the needs of instructors with reduced IT competence throughout the main phases of course management lifecycle. There is a plethora of LMS out in the market that can be used. Diplek is not trying to compete with other LMS. More likely Diplek is intended to be used in smaller educational domains where computer experts are hard to find and the need for an easy to use LMS is prominent. Most LMS simplify only the services that relate to the content management process; nevertheless, instructors have additional needs, such as, to monitor a learners' progress with means that can be easily handled by a typical non IT specialist instructor and to communicate with learners in real time. Diplek offers a special tool for monitoring purposes, which records a learner's activities through a session in video format; this recording can be interpreted at a later time by the instructor to extract conclusions about the learners' progress and the course's contribution in achieving its purpose. Moreover, the system can be operated without an internet connection or a web browser. This flexibility comes in handy in situations where the equipment is old and the connection between workstations is limited to a LAN.

The remainder of this chapter is organized as follows: In section 2 user requirements for LMS are presented, together with currently available solutions. Next, in section 3 a detailed presentation of Diplek educational platform and its services follows. Finally, section 4 presents some conclusions.

## **USER REQUIREMENTS AND EXPECTATIONS**

Over the past fifteen years learning management systems have been embraced by as a technology of significance for creating new revenue streams, reaching new markets, connecting with students in new ways, and/or teaching more efficiently.

At a recent research study done in UK, 90% of schools use LMS or even have more than one LMS in the institution (Baziukaitė, Vaira & Idzelytė, 2008). The reason for this wide acceptance and usage of LMSs is the many advantages that they bring:

- Users can manage and track their own learning
- Personalization of learning
- Access to worldwide learning material

A LMS addresses two specific target groups; instructors and learners, each of which needs to be supported for different roles and actions. Learners are offered educational material and guidance through the LMS, which provides them with tools and services adapted to their needs. Each learner is assigned to an instructor or a group of instructors that are responsible for: creating, delivering and assigning educational material to the learner, monitoring learners' activities, grading learners' performance and providing personal guidance.

The majority of users (learners and instructors) focus on the ease of usage and the way information is presented to them. In short, users expect (Keenoy et al., 2003):

- An easy to walk round environment with a minimum of steps to perform a certain action.
- A consistent user interface providing help and guidance at every step
- Personalized content available for each learner and at each stage of the learning process.

The above features are offered by LMS in the form of services. Modern LMS are built using a service oriented architecture which is a new paradigm that extends the object-oriented paradigm to web-based systems. It uses services as base elements for developing multi system platforms. Services are autonomous platform-independent computational elements that can be described, published, discovered, orchestrated and programmed for the purpose of developing massively distributed interoperable applications (Shen, Wang, Li & Ghenniwa, 2006).

One can derive seven categories of services offered by LMS (Colace, De Santo & Vento, 2003):

- Educational Content
- Integrating-Wrapping Content
- Evaluation & Assessment
- Communication and Collaboration
- Adaptation & Profile building
- Learner Monitoring
- Documentation & Help

## **Educational Content**

The principal function of a LMS is to deliver learning material to learners. Most LMS require educational context to be described in a certain form, using metadata (Anido et al., 2002) to facilitate search, definition, and finding the content in which learners are mostly interested. Consequently, in a context where instructional material consists of Learning Objects, LMS could implement new features to take advantage of the benefits of qualitative metadata, e.g. recommending appropriate activities, or allowing learners and instructors to perform activities such as content analysis, information resource location, or enhanced searches, to name a few. While this is a helpful service, novice instructors find it difficult and time consuming.

Instructors are also assigned with the task of providing help to their learners which involves: support related to the learning content, support related to the learning process and support related to the learning product (Reid & Newhouse, 2004). Learning content support refers to all instructor activities that concern the subject matter (de Vries et al. 2005). Process related support refers to all tutor activities related to the learning process of individual learners or group collaboration. Product related support refers to all tutor activities that pertain to the summative assessment of learner products; such as checking the authenticity of the product or correcting tests.

## **Integrating –Wrapping Content**

One must take into account that a lot of educational material has already been developed in a form that is not presentable by LMS (i.e. standalone applications or material created with a certain authoring tool) and a lot of effort and expertise is required in order to transform it to a suitable form. Besides, transforming a Learning Object from its original format to a compatible LMS format entails the risk of affecting negatively its educational value. A LMS should provide the instructor with tools to include/present educational material in any possible format, as long as it can be rendered in the learners' computer.

## **Evaluation and Assessment**

Gronlund (2006) has written that formative assessment is intended “to monitor student progress during instruction...to identify the students' learning successes and failures so that adjustments in instruction and learning can be made”. Tests and assignments constitute a large part of a learner's everyday educational practice. Instructors are responsible for checking a learner's progress through the course duration and one of the tools at hand is test assignment. When it comes to a LMS, this is offered as a built-in service that makes use of a large variety of tools available to assist both the instructors and learners. These tools range from supporting authoring of multiple choice questions up to project (assignments) management.

## **Communication and Collaboration**

Communication in a computer learning environment can be analyzed in the broader context of computer-supported collaborative learning (CSCL) (Weinberger & Fischer, 2006). This field deals with issues regarding collaboration during the learning processes, and the use of computer-mediated communication (CMC) to support collaboration between learners, in order to enhance learners' learning processes (Kreijns, Kirschner & Jochems, 2003). This group of services is regarded as a

fundamental part of the learning process. Communication in a LMS can be implemented by using emails, built in messaging-chat services, forums, wikis and blogs. These services are the basic elements of the communication service group offered by most LMS.

### **Adaptation & Profile Building**

Adaptation is used to refer to the personalization of learning based on user preferences and user performance along specific criteria. The two main aspects usually involved are adaptivity and adaptability. Adaptation is defined as the ability to change a lesson using different parameters and a set of pre-defined rules. On the other hand, adaptability is the possibility for learners to personalize a lesson by themselves. (Burgos, Tattersall & Koper, 2007)

A user profile can be built based on the user's behaviour, the educational content viewed, or both. A human behaviour based user model can be learned by observing the user's actions such as log files, recording, etc (Kim & Chan, 2008). Building a user profile can be done both manually by the instructor and automatically (e.g. using autonomous agents).

### **Learner Monitoring**

LMS gather large logs of data of learners activities during courses and usually have built-in monitoring features that enable the instructors to view some statistical data, such as a learner's frequency of login, time taken on a course or a test, the number of messages the learner has read or sent, marks achieved in tests, etc.

Instructors may use this information to monitor the learner's progress and to identify potential problems. However, tracking data is usually provided in a tabular format, is often incomprehensible, with a poor logical organization, and is difficult to follow. As a result, Web log data is used by only few skilled and technically advanced distance learning instructors. (Mazza & Dimitrova, 2007)

### **Documentation & Help**

As with any other software, users are satisfied by it when an adequate and well written documentation is available (Sacha, 2006). Moreover, in a Learning Management System that can be used by non computer literate users, help must be available at any stage of the learning process. This help is translated to (Sommerville, 2002):

- Printed manual for the whole software
- Included Help files that are linked and accessible by the current user
- On line Help

## **CURRENT STATE**

A variety of LMS have already been adopted by educational institutes worldwide; some prefer free and open source solutions and some others rely on proprietary software solutions that come with guaranteed support and helpdesk. The need for standardization led a lot of community developers to pursue a way to standardize most of the LMS services. The results of these efforts are reflected in: a) the standards of *e*-Learning architecture (e.g. the IEEE LTSA, Learning Technologies Standard Architecture), b) the description of learning objects meta-data based on shareable XML-based data structures (e.g. through the IEEE LOM specification) and c) the assessment and evaluation of user performance (e.g. through the IMS QTI, Question and Testing Interoperability Schemas). The above specifications enable the common description of learning units, questions and tests, learner profiles, etc, so that they can be easily interchanged between different applications (Sampson, Karagiannidis & Cardinali, 2002).

A further study of the above specifications led to four main categories of services a LMS should offer to its users. These categories include services for:

- Communication between learners and instructors
- Adaptation - Personalization - Extensibility
- People Grouping and General course Coordination
- Monitoring learners' achievements and progress during a course

In the next sections, further explanation and analysis is made of each group of services along with state of the art of LMSs available in the educational community.

### **Communication between learners and instructors**

Most LMS contain tools for conducting conversations. Naturally these rely to a great extent on e-mail and message exchange. It is important to consider how well the learning environment leverages messaging technology to support the conversation as an integral part of learning (Britain & Liber, 1999). For example, a good conversation tool should be accessible directly from the learning topic within the course structure and the user should not have to move out of the course work in order to continue the conversation. One should take into consideration whether the communication tool allows attachments to be included within messages, and if so, whether the attachments can be extracted and embedded into the user's personal folder or portfolio.

Another key point is whether the service allows learning goals to be specified and recorded during a conversation. Ideally the agreed learning goal should be in a prominent location with respect to the topic of learning. Some of the most popular communication tools are integrated email clients, forums and live chat rooms. These exist in many LMSs platforms.

A good example is the COSE LMS (<http://www.staffs.ac.uk/COSE/>) that was developed during a research project at Staffordshire University. COSE supports email, forums and chat tools. All email interactions are automatically grouped for easy search and indexing. Email is outgoing only since COSE is designed to work with each user's default email system.

Another distinguished example is Moodle (<http://moodle.org>). Moodle is an open-source platform that is widely used by educational institutions worldwide both for its open architecture and the many components available free on the web. The philosophy behind Moodle has its roots in Social Constructionism (Dougiamas & Taylor, 2003).

Moodle offers its users a series of communication services; like instant messaging, forums and chat rooms that are easily configurable and adjustable to course planning. Communication tools can be used while in a course or as an independent part of the platform. Moodle uses a combined method of email and instant messaging. A conversation between two users in Moodle is conducted in the messenger window and is send as an email so that both users have a copy of the conversation. Email is also used to inform forum members about new posts. This is very useful for large installations of the platform where instructors need to keep track of posts in a forum.

### **Platform Adaptation and Extensibility**

Adaptation is a term that addresses to both the educational and the technical level of the platform. An e-learning course should be designed to match learners' needs and desires as closely as possible, and adapt during course progression (Graf & List, 2005).

Adaptability is a term used to address the easiness of customizing the platform to learners and institutions needs. Each learner or group should have access to learning content designed or modified for their special needs. The adaptability of the learning environment user interface is also desirable. Not all learners need to have access to all LMS services, as this would increase the level of difficulty for performing a specific task. (Britain & Liber, 1999)

Extensibility is a term that refers to the technical level of the platform. New and updated components can be incorporated into the platform and provide learners with new functions and services. These components can be obtained from third party developers or can be created by the instructor itself. This kind of adaptation is mostly wanted since the learning environment can be transformed to fit the learner's needs.

A good example of adaptation offered by an LMS is E-class. This LMS was adopted by the Greek Universities' Network (GUnet) for the support of asynchronous blended learning in Greek Higher Education. It was constructed based on the open source software Claroline (<http://www.claroline.net/>) with the addition of new features, such as adaptation into Greek (Papastergiou, 2007).

Moodle introduces users with a state of the art role management system. Each user is assigned a role in the system or in a course. Each role has access to specific services and modules. Instructors can edit or override learners' role so that learners can only access and interact with certain portions of a course. Besides the role system, another option is given to course designers, to hide and publish modules in a course. A hidden object can only be seen by instructors or course creators. This is useful for hiding unwanted modules from learners with a click of the mouse.

### **People Grouping and General course Coordination**

Teaching is best organized when learners are organized in small flexible structures. That is the definition of a class or group. Instructors have fewer learners to manage so more attention is given to each member of the group. Most LMSs support class or group formation.

Coordination in a LMS is interpreted as scheduling for good resource allocation in the platform. Resources include classes, courses, users, assignments and other entities in the system. Coordination in a LMS is necessary since instructors have to be assigned with a certain number of groups-classes, learners must be enrolled in the right group or class and assignments must be given to the right groups.

Like classrooms, many LMSs provide limited opportunity for flexibility here. Just as a 1 hour lesson in a lecture theatre encourages coordination by sitting still and being quiet so that the class can all learn together, many LMSs encourage a method that can be caricatured as "read this material, check the forum and do the test". It takes some effort on the part of the instructor to overcome these, but they do – and are supported to some extent by the design of the system. If you can move the chairs, you have more choice in a classroom; if you can adapt the workflow of a LMS, you can provide more flexibility in your learning opportunities (Britain & Liber, 1999).

Almost all of the LMSs available in the education community give the ability to their users to be divided into classes and groups. Some of them allow the customization of what a group of learners has access to do and view. Moodle is one of them. Moodle offers its users the potential to assign more than one instructor to a course for better coordination

Blackboard is a LMS which incorporates a wide range of teaching and learning tools into a web-based interface (Taha, 2007). The Blackboard LMS offers a suite of coordination features to facilitate some key administrative processes as group discussion, chat room for promoting exchange of ideas between classmates, virtual classroom, and course calendar.

### **Monitoring learners' achievements and progress during a course**

The effective use of LMS requires that instructors are provided with appropriate means to diagnose problems so that they can take immediate actions to prevent or overcome that problem (Mazza & Milani, 2004). Monitoring is usually a core service of most LMSs and is implemented both as a user actions tracking service and as an assessment and evaluation service, each of which has its own benefits.

To be able to track down the actions of learners is a major advantage in asynchronous e-learning systems. Instructors can cope with their learners by checking what resources have been viewed during a course session. Furthermore instructors can follow up with conversations between learners by tracking the logs of each chat.

Moodle keeps track of user's actions by using the logs reporting service. Administrators have access to detailed logs which can be filtered per user, date, action and course. An enhancement to this service is the statistics module which enables administrators to have a supervisory view of what is going on the platform by visualizing recorded data and presenting it as graphs.

Another way to monitor learners' progress is via the assessment and evaluation service. Learners are subjected to test and quizzes and according to how well they perform an overall picture can be drawn about their learning progress. Assessment methods should be used to measure what learners can do with what they know, rather than what they know (Struyven, Dochy, Janssens, Schelfhou & Gielen, 2006, pp. 203). The standard method of assessment and evaluation in almost all LMSs are quizzes or multiple choice questions. Another method available is assignments. Instructors assign small projects to their learners and grade them according to what they submitted back in the platform.

An instructor using the Moodle platform can add a quiz in a course by selecting questions from the question bank and publish it. Instructors can choose how many questions show up in each page, as well as timing, penalties and grade options. Moodle also provides tools for project assignments. Learners can submit their projects to the platform both as draft and final. Instructors can then process them, make comments and grade them using the platform.

Like Moodle, Atutor (<http://www.atutor.ca/>) is another LMS that offers the above services. It is an Open Source Web-based Learning Content Management System (LCMS) which includes tools for Tests, Surveys and Assignments. An instructor can easily create a test by selecting/create question from the question database. A nice and interesting feature is the certificate of completion. Learners who complete the test are given a certificate of completion.

### **LMS services Comparison tables**

In this section of the paper, a comparison is made among three popular LMS and Diplek (Platform features and services will be presented in the following section). LMS are categorized based to services offered and services components. The comparison involves the following LMS: A-tutor 1.6.1 (open-source), Blackboard Academic Suite (Release 8.0) (commercial licence), Diplek 1.0, and Moodle 1.9.4 (open source). All components taken under consideration are built in the system and are not offered as third party components.

<b>LMS</b>	<b>A-tutor</b>	<b>Blackboard</b>	<b>DIPLEK</b>	<b>Moodle</b>
<b>Components</b>				
<b>Communication and Collaboration Services</b>				
<b>Forum</b>	<b>X</b>	<b>X</b>		<b>X</b>
<b>Chat</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Email</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Blogs</b>	<b>X</b>	<b>X</b>		<b>X</b>
<b>Content management Services</b>				
<b>Documents</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Metadata</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Calendar</b>		<b>X</b>	<b>X</b>	<b>X</b>
<b>Teaching Assistant</b>			<b>X</b>	
<b>Evaluation &amp; Assessment service</b>				
<b>Assignments</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Multiple Choice Questions</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>

<b>Grading System</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Monitoring Service</b>				
<b>Action Logs/ Reports</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Video Recording</b>			<b>X</b>	
<b>Adaptation &amp; Profile Building service</b>				
<b>Role System</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Group Management</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Dynamic Profile</b>				
<b>Course Themes</b>	<b>X</b>	<b>X</b>		<b>X</b>

*Table 1. LMS services comparison*

## DIPLEK PLATFORM

Diplek is an open educational LMS that allows learners and instructors to easily manage learning resources in an integrated system. The platform design follows all modern educational software design guidelines and learning standards. Diplek is distributed under a creative commons Attribution-Share Alike Unported 3.0 license, where users can copy, distribute, transmit and adapt the platform as long as they distribute the resulting work only under the same, similar or a compatible license. Both the installation and the source code files are freely available to users.

The Diplek platform adopts a 3-tier architecture. The platform operation is composed of group of services offered by several autonomous components that cooperate with each other and give the user the look and feel of a modern classroom. Users type their credentials and authentication service processes them. Each user role has a different access level; users are classified into learners, instructors and administrators.

### Technical Overview

The development of Diplek was based on Microsoft Visual Studio platform and Microsoft Visual Basic 2005 programming language (Balena, 2006). On the backend a MySQL Relational Database Management System (RDBMS) (DuBois, 2008) is responsible for holding all the platform data. The connection between the application and the backend is possible by using the ADO .NET MySQL connector (McClure, 2006) and the TCP/IP protocol. Some of Diplek's services were developed by reusing and adapting code that came from the Moodle project but due to the different programming languages used (Moodle is developed with the PHP programming language) some refactoring of classes and functions were required.

As with any other platform based on Microsoft .Net technologies, Diplek requires the Microsoft .Net framework (Richter, 2002) to be installed for the platform to run smoothly. To support centralized access to Diplek's repository, a database server is needed to host the MySQL database. The hardware requirements needed to run the platform are set to a minimum. A recommended configuration for the database server would be an Intel Xeon processor with 2 GB RAM, at least 1 GB of free disk space and a network adapter that supports the TCP/IP protocol. For the workstations, the minimum requirements are: a Pentium III processor with 512 MB of RAM, a VGA compatible Graphics card, at least 100 MB of free disk space and a network adapter.

Before setting up the database server it is crucial to point out how many concurrent users will be connected to the platform and the amount of LOs the platform will hold. In order to maximize the number of concurrent connected users on the platform, more processing power is required for the database server. The amount of LOs stored in Diplek's database is only limited by the free disk space on the database server. All LOs are stored in database tables in binary form. Diplek is tested to work under Microsoft Windows 2000, XP and Vista. A new version will be soon available to support Microsoft Windows 7.



## **Platform Initialization**

The platform initialization and loading phase consists of three stages. The first stage concerns user entrance. When a learner user enters the system, the course selection service is activated and the learner has to select a course to attend to. Afterwards, the user has the option to retrieve the last saved state of the system or to start a new session. Either way, the virtual assistant and session recorder services are loaded. The session recorder service is responsible for monitoring the user's learning path in the platform. The virtual assistant service pops up a kind of "Microsoft agent" component that is programmed to assist the user in his very early steps with the platform, so that novice users will know what to do without any guidance from the instructor.

The second stage of initialization aims at setting up the user's learning workspace. This involves retrieving the user's access level to menus, tools, options and learning material. The service assigned for that purpose is called "Profile Activator" and it is responsible for presenting the user with only what he needs to see or what the instructor has permitted him to see.

The final stage of initialization sets up the learning material assigned to the learner, which may include course presentations, project assignments and multiple choice tests. The course outline is always visible to the learner and all other windows appear on top of that. This three stage procedure is repeated each time a user enters the platform.

A very similar procedure is followed with the instructors. When a user identified as an instructor enters the platform, the instructor "Profile Activator" service retrieves all the available information needed and forwards it to the corresponding services. One of these is the "Course Configuration" service which provides the instructor with options like course description, course outline, learners and groups admitted to the course, etc. The "User and Groups Configuration" service provides the learner with information about a user, like place of living, email address, full name, mother language, groups involved and courses taken. All these can change with the click of a mouse button. This service is also responsible for setting up the user – group access to tools and resources for a specified course. The "Assignments" service allows the instructor to assign to learners or groups projects and exercises. All the delivered assignments are presented to the instructor for manual correction and evaluation. Finally, there is the "Test Creation" service for creating multiple choice tests and assigning them to learners. This service communicates with the "Grade" and "Statistics" service.

An administrator is a user with the same privileges as the instructor. This special user category can do exactly what an instructor can; in addition he is eligible for two extra functions. When an administrator user enters the platform, both the instructor and the administrator "Profile Activator" services are loaded. Together with these services, two other services are loaded, the "Database Configurator" and "Session Recording" services. The former is responsible for connecting the platform with a compatible learning material repository. The latter is monitoring system configuration. The instructor/administrator can choose what users or groups are going to be monitored and for how long.

## **Platform installation and deployment**

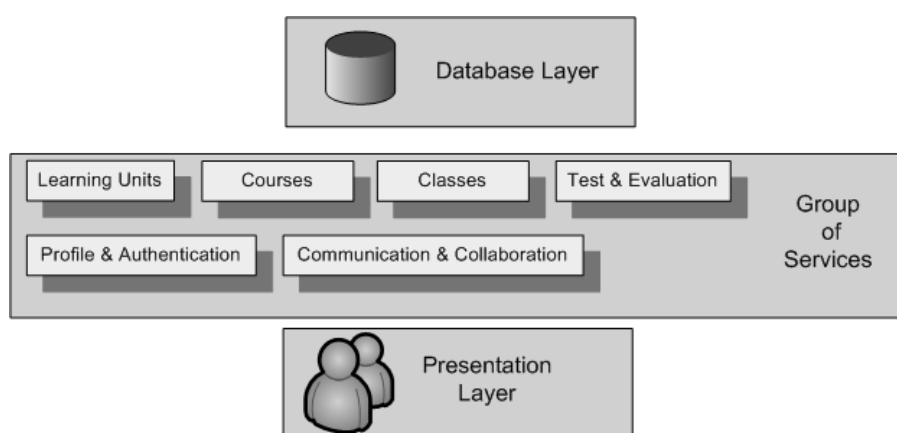
Diplek is intended to be installed in both organizational-educational environments and home environments. In the first case, a server is needed to host the platforms database where the educational material and user data are stored. This database can be made available through the Internet so that the client workstations can connect to it from any point in the world. This kind of installation is suitable for schools and universities, where learners are divided into classes and each class is assigned to a group of instructors. Each user (learner & instructor) can connect to the platform through a local area network or through the Internet. Each client workstation needs to have a Diplek client installed in order for the platform to function properly.

In the second case, where Diplek is installed in a home environment, the users' workstation acts both as a client and a server. That means that the platform is installed locally and can serve users connected to that workstation only. This kind of installation is suitable for users who cannot gain access to permanent network connectivity.

Diplek comes with an automated configuration utility that helps the system administrator to an easy platform installation. The configuration utility is responsible for setting up the database connection and tests whether the platform is installed correctly.

### Diplek Layers

As mentioned before, Diplek is using service oriented architecture (Erl, 2005; Papazoglou & van den Heuvel, 2007). This design enables the transparent addition of extra functions after the platform is deployed thus offering the users new tools and services. Figure 1 shows the three layers.



*Figure 1. Layer Schema*

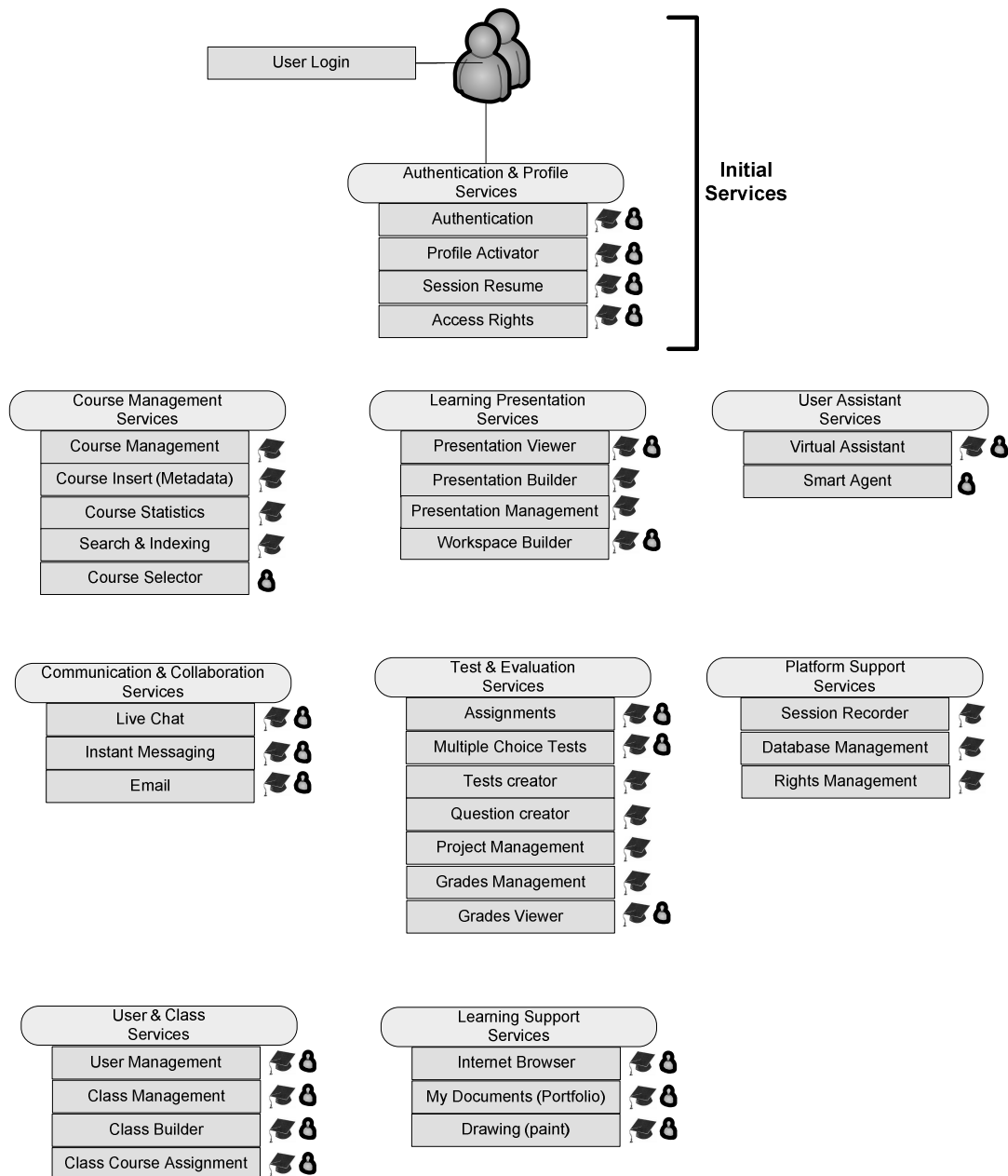
The database layer is responsible for storing user and course data. These data are stored by using a logical organization like tables. This layer is also responsible for offering the necessary bridge for connecting the stored data with the system services.

The services layer is the connecting link between the database and the presentation layer. Before content is displayed to the user, it is filtered and rearranged by the different group of services that intervene. As with any other service oriented system, services interact with each other. For instance, the “Live Chat” service interacts with the “Course Management” service in order to enable members of a course to chat either in private or in a live chat classroom. This service is disabled in some cases, like when the “Test & Evaluation” service is active.

The layer responsible for presenting information to the user is the presentation layer. The entire graphical user interface is controlled through this layer as well as all user-system interactions.

Platform services are made available to users according to the user level they have. The authentication service is responsible for distinguishing which user runs what service and sets the level of functionality of the service. For instance, the logging service can be used only by administrators and instructors, but when a learner is authenticated, logging starts only for session recording, not for viewing.

Platform services are grouped by their functionality and their target group, e.g. live chat, email and instant messaging are grouped under Communication & Collaboration Services. Some of these services are only offered to instructors whereas others are offered both to instructors and learners. Figure 2 shows the grouping of services along with the services each group has.



Service Available to Learners  
 Service Available to Instructors

Figure 2. Diplek Services Scheme

## EDUCATIONAL MATERIAL & LEARNING OBJECTS

There are many definitions of a Learning Object (LO). Polsani (2003) describes it as “an independent and self-standing unit of learning content that is predisposed to be reused in multiple instructional contexts”. According to the Polsani’s definition, a Learning Object can be anything from a simple text document to an interactive multimedia game or even a complete webpage. But more significant, is the fact that a Learning Object can be reused in many educational contexts. McDonald (2006) describes a LO as ‘the result of applying a finite set of rules to a simpler learning object, in order to construct some meaning, activity or purpose which is used for learning’. The reason for this being so important

is that an instructor can use an already developed, used and tested LO to teach a course without the need to create from scratch a new one. Non computer expert instructors consider this as a handy tool.

One of Diplek's key functions is the storage and cataloguing of educational material. Each instructor is responsible for finding and inserting the appropriate resource to Diplek's main repository. This repository is held into the platforms storage database and access to it is granted to all users. Each user has different access rights e.g. instructors can store their LO and view what others have stored, whereas administrators can view, change and store LO. Instructors have the option to grant others with privileges for copying and changing learning units owned by them. The next level is the presentation of this material. In order to support reuse of LO, Diplek permits access to all material in the system database, even the one that has been created by other instructors (as long as the creator permits it). As said before, this material can be of any type and any size as long as it keeps up with the database storage requirements (amount of data each user can store). These requirements or limitations are defined by the system administrator.

As the available educational resources grow larger each day, the need for extra information becomes obvious. The lack of information about the location, properties, educational context or availability of a resource could make it difficult to use. Metadata contributes to solve this problem by providing a standard and resourceful way to conveniently characterize resource properties. In this way, instructors with not much experience in using learning management systems can find the Learning Object they are looking for by describing some of its properties.

### **Data to describe Learning Objects (Metadata)**

The capability to associate metadata with LO makes Diplek a powerful tool for easy search and indexing. Metadata (Jing, Li & Fang, 2005) are conventionally defined as data which is used to describe data and it provides a means to describe the information of learning objects. Metadata are used to describe document contents and structure, and to provide information about accessibility, organization of data, relations among data items, and the properties of the corresponding data domains.

However, metadata can also be used to provide descriptions for non-textual objects, like images, videos and sounds. Nowadays, hundreds of collections worldwide already adopted metadata as the basic tool for information representation and cataloguing.

The radical development of learning management systems and the use of metadata to describe Learning Objects brought up the need for metadata standardization so as to enable reuse and interoperation among heterogeneous platforms. To accomplish this, an agreement is needed on architectures, services, protocols and open interfaces.

Several initiatives took place aiming to deliver a standard set of metadata that would describe a Learning Object such as IEEE Learning Object Metadata (LOM) (Edvardsen & Sølberg, 2007) and Dublin Core Metadata Element set for education (DC) (Baker, 2005).

LOM specifies the syntax and semantics of learning object metadata, defined as the attributes required to fully and adequately describing a Learning Object. This includes element names, definitions, data types, vocabularies, and field lengths. LOM is focused on the minimal set of attributes needed to allow these Learning Objects to be managed, located and evaluated. Related attributes of Learning Objects to be described include author, type of object, terms of distribution, owner and format. Where appropriate, learning object metadata may also include pedagogical attributes such as teaching or interaction style, grade level, level of difficulty, and prerequisites.

Dublin Core Metadata Element Set (Baker, 2005) is a general-purpose and widely adopted metadata scheme targeted to resource location developed within the Dublin Core Metadata Initiative. It is compact and its elements are the result of a wide consensus. The DC-Education is a Working Group

that was formed to develop and make a proposal for the use of Dublin Core metadata for the description of educational resources. Essentially, its task is to propose extensions to the DC metadata set to describe these kinds of resources, taking LOM and the IMS Global Learning Consortium proposal as a basis.

Diplek uses IEEE LOM standard for its learning object repository. The reason for choosing LOM among many other well defined and documented standards is that it fully describes both the educational and technical aspect of a Learning Object. Although LOM contains a large number of attributes, Diplek requires only a small set of basic attributes to be inserted in order to allow a Learning Object to be catalogued. In this way, instructors are not obliged to fill the complete form and hence can save time. The use of IEEE LOM makes Diplek Learning Object repository easy transferable, interoperable and searchable. The set of metadata used to describe a Learning Object includes general data (title, description, language, keywords), life cycle data (creator, status, version, people contributed), educational data (level of education, type of learning object, interaction level, difficulty) and technical data (type of object, installation instructions, platform requirements). The more attributes are filled, the more accurate the result of a search for a Learning Object will be.

### **Importing Educational objects into the platform**

Before creating a course, instructors need to insert educational material to the learning object repository. All Learning Objects are catalogued using IEEE LOM schema. Diplek provides an easy to complete wizard for novice users, which is divided into four steps according to the categories of metadata schema; general, life cycle, educational and technical attributes. After completing the wizard the final step is the insertion of the Learning Object. Instructors can insert any type of educational material, like multimedia presentations, sounds, WebPages, applications, archives, games, etc. Diplek accepts all file formats. As mentioned before, one of the main advantages of the platform is the ability to import any kind of material, even software, as long as the appropriate viewer is installed on the client's machine. In this way, all educational material can be used without any modifications or limitations.

Diplek is not educational material creation software; it is a platform that utilizes all the available educational material in order to present it to the learners. So importing the educational material is just the first step of creating a course for learners to use it.

### **Content versioning**

By using learning object metadata Diplek can store different versions of a Learning Object. This is done by entering the version number in the life-cycle tab. Each version of a learning unit is stored in Diplek's main repository and can be accessed at any time. Apart from version information, contributors' names and roles are also provided, along with content status information (final, draft, revised, approved).

### **Searching for the appropriate educational object**

The second step is finding the appropriate material that will be presented to learners. To do so, a search tool is available that queries the platform's learning object repository using criteria based on learning object metadata (type, difficulty, level of education, language, keywords, topic, etc.). All Learning Objects that match the required criteria can be selected from the list. When a Learning Object is selected, it is copied in a new list. This list contains all the candidate educational material to be used for the course.

### **Educational material statistical data**

Even though instructors have access to all educational material, there are times that an instructor just wants to have an overall picture of what is going on in the whole system. Diplek provides instructors with an easy to use statistics tool. Learning Objects are grouped according to the user-selected metadata information. For instance, one can see the amount of Learning Objects available for each

level of education. All the educational material stored in the database, can be used to provide statistical data to the instructor. These data are presented in a pie chart for better understanding.

By examining the appropriate statistical data, an instructor can get a general picture of the LO stored in the platform database and take the necessary measures to increase the volume of educational material in learning areas mostly needed.

## Creating powerful presentations from Learning Objects

Course presentation is the final step of preparing a course. These presentations must not be confused with the usual slide show presentations. A course presentation is an organized structure of learning units categorized in such a way so as to serve the group's educational needs. All educational units used to form the presentation can be accessed by double clicking with the mouse on their icon. These presentations are assigned to groups or specific learners. The ability to distinguish what each user is viewing-using is a vast advantage since the instructor has the ability to alter a presentation/course according to each user's special needs.

Diplek supports the creation of course presentations with an easy to complete wizard. Figure 3 shows the screenshots of the wizard. First, instructors fill up the general course details like title, description, etc. These details are shown to the learner as an introduction text when the presentation is selected.

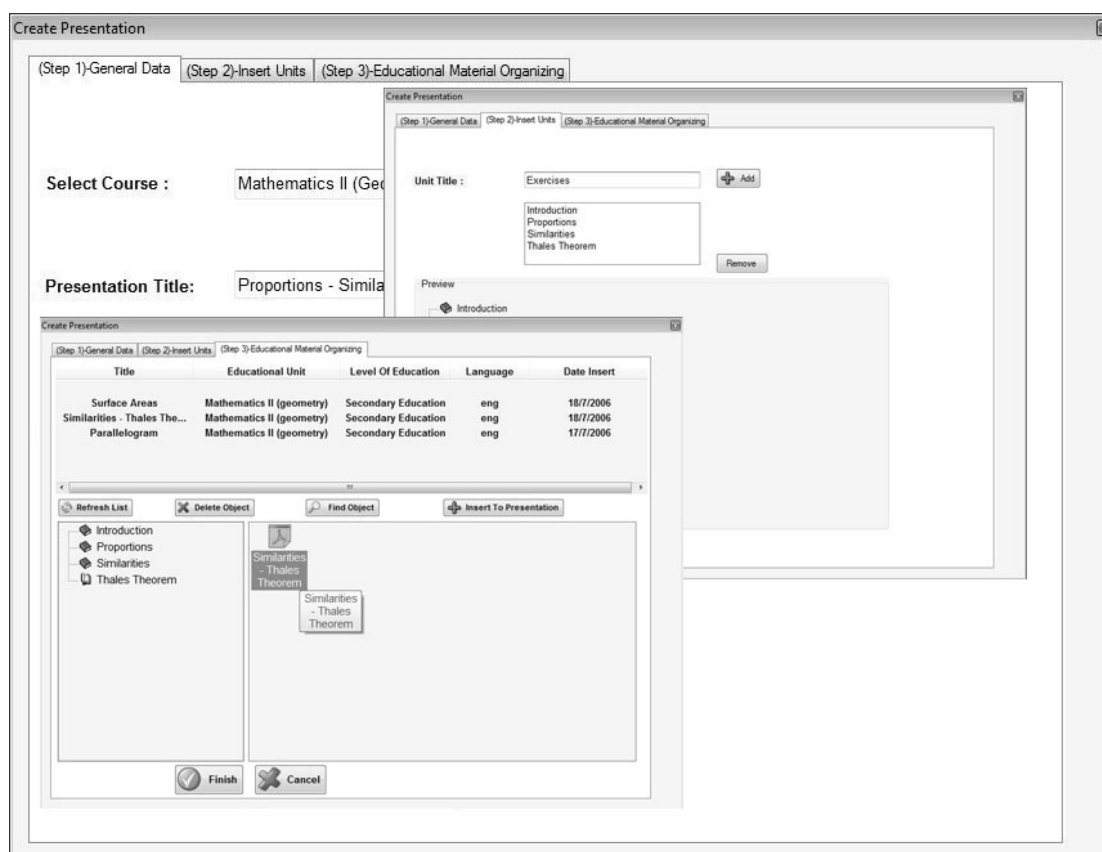


Figure 3. Screenshot - Creating a Presentation

Next, follows the creation of presentation units. Each presentation unit is a set of LO. So, a presentation unit can be a book chapter, a lab experiment, etc. It is up to the instructor to choose how to present a course. In this form, instructors simply define the presentation units by entering the title of their choice. Presentation units can be used for indexing a presentation and help learners find what they are looking for.

The final stage is the distribution of LO to the corresponding presentation units. A LO can be used in one or more presentation units or presentations. Each educational object assigned in a presentation is represented by an icon. Depending on the type of object, each icon has a different image (a generic icon is used to represent object types not recognized by the file system).

A presentation can be deleted or reused. Reusing a presentation can take many forms. One can reuse a presentation to teach the same course or alter the presentation to fit a different educational domain. The presentation created by an instructor can be used by other instructors as is or altered. LO that are copyrighted are protected since copyright information is stored in the LOM set.

## **SERVICES OFFERED TO USERS**

User services relate to platform services available to all course users except those not related specifically to course learning material (e.g., messaging between learners/ instructors, calendar, live chat, and document exchange services etc) (O'Droma et al. 2003).

Diplek includes a number of tools to enable learners with organizing time, organizing personal workspace, checking course grades, etc. These services run as components and can be configured by the instructor. All tools use a common User Interface and use simple command buttons to perform an action. The design of these tools was made taking into account the difficulties a novice user faces when using them. The following tools are meant to be used both by learners and instructors.

- Profile Manager
- My Calendar (Figure 4. A)
- Sketch book (Figure 4. C)
- My Grades (Grade Book)
- My documents (e-portfolio) (Figure 4. B)
- My mail (Figure 4. E)
- Live chat (Figure 4. D)

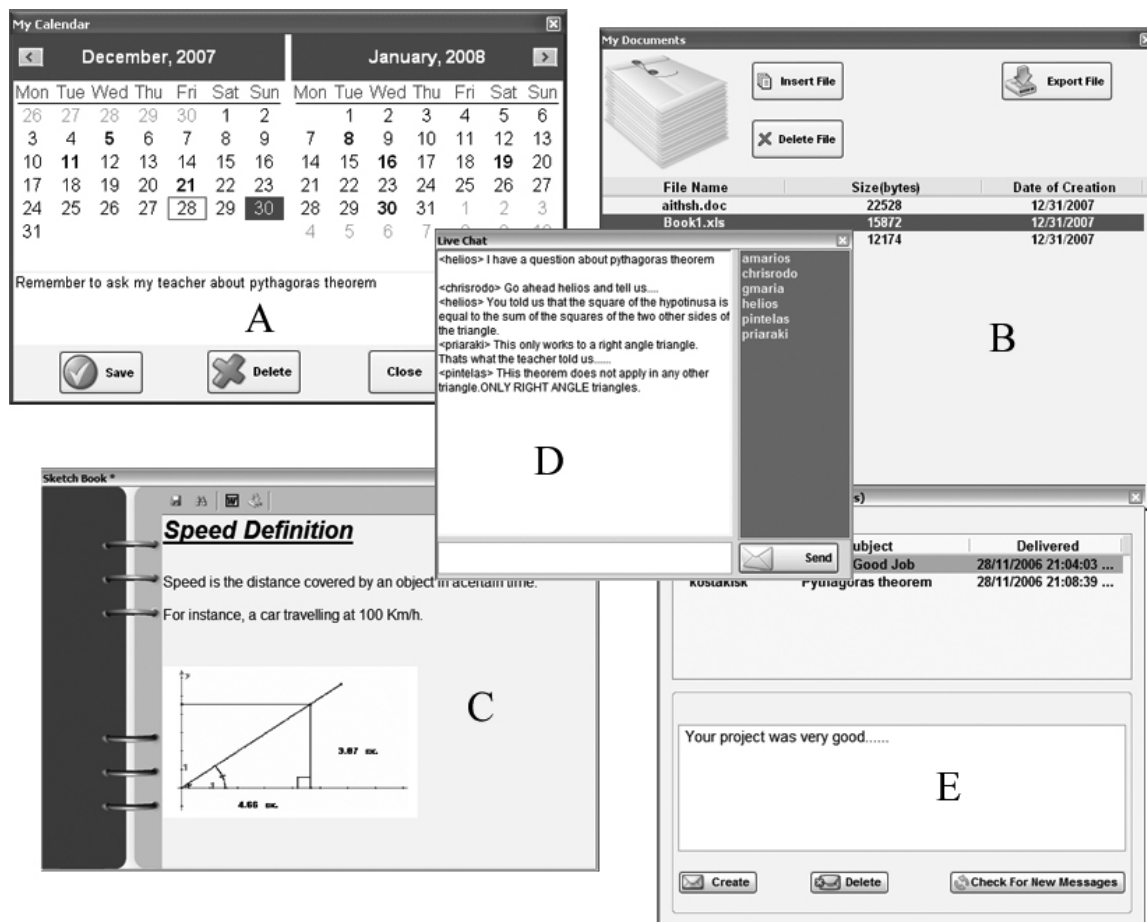


Figure 4. Screenshots of tools and services available to users

## Profile manager

Profile Manager is a tool used to allow a user to change personal information (email, name, address, etc.) and account password. This is a general usage tool that helps users to maintain the correct contact and personal information. In order for a learner to change the educational material presentation language, only a click is needed at the relevant field.

## My Calendar

Calendar is a powerful feature that allows learners and faculty to manage both academic and personal events. Managing time is one of the most important things a learner and an instructor need to do. A learner must be given the ability to schedule lectures, tests, assignments and other learning processes during a week/month/year.

Instructors need to mark important dates and schedule learning activities. This tool is useful for learner users who can schedule their lectures, tests and assignment delivery. All the days are shown on a weekly base and the dates that have events schedule are shown in bold. Users can schedule an event by just clicking on the date and type the desired text. The calendar service is directly connected to the virtual assistants' services to inform user with upcoming events.

## My Documents

Diplek supports personalization of learning and encourages users to have their own personal workspace where they can store files. These files can be anything from a single text file to an interactive multimedia game. All documents (files) can be extracted with a single click of the mouse and can be transferred to another user of the platform or even a learner or instructor of another system.



## **Sketch book**

Another tool that follows the learning personalization logic is the 'sketch book'. The use of this tool provides user with a place to enter information coming from different sources (internet, educational objects, chat, etc.) and store them in a container that is always available during a session. Learners can search information in the web and insert it to the sketch book. This information can be saved as formatted text combined with images, and other multimedia features like sound, video, animation, etc. All information stored in sketch book can be formatted, searched and extracted to all known document formats (.doc, .ods, .rtf, etc.). Sketch book can be easily used by novice users since all functions can be accessed from the main menu and by clicking the right mouse button. The layout of the window resembles that of an exercise book and all actions can be performed either from the top menu or by right clicking with the mouse on a word or other text. Sketch book cannot be closed until it is saved or the user confirms closing without save. This is a precaution taken because most users often forget to save the work done before exiting.

Diplek provides several other useful tools that can be used to assist learners like a calculator, a drawing tool and a web browser for internet access. Another category of tools provided by the platform are the collaborative-communication tools.

## **Collaborative-communication tools**

This category includes tools and services directly related to the learning process that are responsible for distance communication and collaboration of learners and instructors. These tools aim to assist users (mostly learners') to keep in touch with their peers and instructors (Kear, 2007). Even though, the most frequently used communication tool is e-mail and it is mainly used for personal correspondence among the learners (Vorides, Sanchez-Alonso, Mitropoulou & Nickmans, 2007), there are other communication tools like instant messaging, live chat and discussion forums. Communication tools are better used in conjunction with the course instead of as a standalone service. Diplek offers three kinds of communication tools: integrated messaging tool, live chat and email. Email tool is offered as a web service whereas the other two are integrated inside the platform and can be used without the existence of an internet connection.

### **Live chat**

Live Chat (or instantaneous mail) allows a real time discussion between all members of the platform. This is an exciting way for learners to communicate directly with each other in real time, and a unique way for instructors to answer learners' questions during office hours. Live chat discussions can be archived for later review. Diplek does not require complex setup of chat space and the tool is ready for use when a user selects the chat option. All conversations in the room are public so that everyone can watch and participate.

An instructor can use this tool to give guidance to learners from distance while they are watching a presentation or working on a project. This way, all learners get the same information and can ask questions that everyone can see. The use of this tool is needed in order to build a collaborative community that each user learns from the other.

This tool is not recommended to be used for personal messages since every one that is in the room can see the message. For that purpose another tool can be used called 'My Mail'. This tool is a simple messaging system for all the users that have access to the platform.

### **My Mail**

A less exciting but still as useful as the live chat tool, is the 'My mail' service. This tool is needed for users to communicate with each other in private. The way this tool works is similar to that of the email service, but instead of email addresses, users only have to know the username of the user that

they want to communicate with. Also, this tool does not require the existence of an internet connection.

All communication logs are available to the user through a centralized system. This system gives the ability to the user to delete, create and check for new messages. An instructor has the ability to send a message to the whole classroom or to a specific user whereas a learner has only the ability to send a message to a specific user (learner or instructor).

### **A usage Scenario**

The local water board of a Greek town decided to apply new and more efficient techniques in water pipe connections. In order to apply those techniques on a right manner, the organization contacted a British company that specializes in pipe mending techniques. The British company decided to offer a six hour distance training session for the Greek organization staff.

Due to the short time available, the British company agreed to use Diplek LMS for course delivery and support. Mr Smith is the professional expert responsible for the training course. He gathers some video of field work done on pipe mending and some documents including specs, technical requirements and best practices. After reading Diplek's usage manual and taking a little practice on his own, he starts by creating a user account on the platform. Then he creates a course and a class by using the wizards available. To speed up the process he imports all learning material (video and documents) and creates a single presentation with three units. Each presentation unit represents a step on the pipe mending procedure and includes both video and documents. To be prepared for the course he creates six learner accounts for the Greek organization personnel and enrolls them in the course and class previously created.

In order for the session to start, each learner uses the credentials previously created by the instructor. Mr Smith uses the Live Chat service to welcome all users to the training session and presents himself. Then, each learner clicks on the presentation and watches the videos. Some learners have questions and ask Mr. Smith. During the course, Mr. Smith needs to send some extra documents to the class which are not included in the presentation. He opens the My Documents service and shares the documents with the whole class.

At the end of the training session Mr Smith logs out of the system but some of the learners stay connected to watch some of the videos again and save the educational material on their usb drives since the instructor gave them permission to do so.

## **LEARNERS' EVALUATION AND ASSESSMENT**

Byers (2001), describes interactive assessment in learning environments as promoting dynamic feedback and course corrections on the fly. This part of the platform measures learner performance against specified goals, using a variety of services ranging from multiple choice questions to complex assignment handling. In order for instructors to monitor the progress of learners, it is necessary to provide services and tools for evaluation. Evaluation is the procedure by which learners are tested for their understanding of a certain subject. The results of evaluation can show what difficulties the learner encountered when studying this subject. By having these data, the instructor can customize the learning path (learning material, course presentations, tests, etc.) to the learners needs.

There are many ways for evaluating a learner's progress. The most common are tests, projects and assignments. In order to cover most of these evaluation methods, Diplek includes tools that automate the above procedures. Due to the low usage reported on these tools (Philips, 2006), an easy and intuitive wizard-based method is introduced in order for instructors to use them.

### **Multiple choice tests**

Most LMS provide templates for multiple-choice questions, true/false questions, matching questions, or short answer questions (Govindasamy, 2001). Multiple choice tests are an easy way of assessment and evaluation. Nevertheless, it is also a way for learners to check their learning progress. To manage the creation of multiple choice tests, Diplek incorporates services for question and test creation, test delivery and test result analysis. Instructors can create a number of questions with the desired set of answers. Each question can be given a difficulty level and can be included in one or more tests; if the instructor permits it, it can also be shared by other instructors on the platform. When the test is ready, it can be assigned to a learner or a group. Multiple choice tests can be used both for assessment and self evaluation.

When a test is finished, a log file is created. Instructors can view all available information by using the test results analysis tool. Instructors have access to information like the number of correct answers, time needed to complete the test, answers given by the learner, total number of tries for each test and the total score.

Instructors have also access to test statistical data. This data is collected for each test and can be used for test quality evaluation. In simple words, an instructor can see if a test is suitable for a group or a learner and make the necessary changes so that it fits the learning goals.

Multiple-choice questions, as all assessment methods, have limitations and are suitable to some content more than others. In the long run, multiple choice questions are a quick and easy way for the instructor to automate the evaluation procedure. This automation saves instructors a lot of valuable time which can be spent for helping out the learners. This is not the only way used to evaluate learner's progress.

### **Project - Assignment Management System**

Another method used for assessing a learner's performance is the project assignment service. This is a very common method used in many educational institutions. Learners are involved in a search and learn procedure guided by their instructor. At the end of the day they present a document with their findings. Diplek supports this assessment method with the use of the project management service. This service can be used for the creation, delivery and evaluation of an assignment.

Instructors can create or import projects through a user friendly wizard, where they are asked to insert the guidelines, instructions to learners, relevant files and deadline. After that, they can assign the selected projects to groups or individuals. Learners are notified for the new assignment by either the teaching or the virtual assistant service. When the project finishes, learners deliver it to the instructor by using the platform delivery tool. Instructors evaluate the project and mark it as checked. All checked projects are available to both the learner and the instructor with added comments and corrections.

### **Grading system**

Even though, grading learner's work is not an evaluation method, it is a part of the whole evaluation subsystem of Diplek. Instructors should be able to manage, update and view their learner's grades. This is a process supported by Diplek with the use of grading service. Instructors can choose to share all grades or specific grades with learners in the Grade book. Learner evaluation is facilitated by easy access to the thread work, journal work, exams and online activity of each learner.

'My Grades' tool provides the instructor with a list of all learners attending a course where he or she can assign a grade to each one of them. Learners have access to their grades and can see them as a list. Sometimes it is more convenient to just have a printed list of all learners and their grades to be published in the announcement board or delivered as an email. 'My grades' tool gives instructors the option to do that with an export tool that saves a list of grades as a spreadsheet.

Instructors can get statistics for each group or course regarding their grades assigned to learners enrolled in the specific class or course. Statistical data is separated to grades per course and grades per group. This way, an instructor can have a general picture of how a class is doing and the suitability of a certain course.

## ADJUSTING WORKSPACE TO LEARNERS' NEEDS

Diplek has a dynamically formed workspace. This means that the workspace can be adjusted to fit learners and courses needs. The learners' workspace includes menus, toolbars and the main screen. The main screen is covered by the active presentation which is course dependant. This means that user's active workspace is formed according to the instructor's specifications and course planning. Menus and toolbars can be adjusted by the instructor so that they match the course context.

Instructors can adjust what their learners can access during their session. These adjustments include restricting the services offered by user tools, educational tools, communication tools and quick access toolbars icons. Access to these services, when restricted by the instructor, is not permitted in any way including mouse, keyboard or shortcut keys.

By restricting access to certain services, we make sure that the structure of a course is maintained. For example it would not make any sense in a theoretical course to use a calculator or when testing learners to have the instant communication service activated. By customizing a learner's workspace we make sure that simplicity is maintained. All these settings can be made by the instructor or the administrator by using the user access service provided. An instructor can customize the workspace of an entire class or a specific user by toggling the lock and unlock button next to each tool (Figure 5).



Figure 5. Screenshot - Setting up the learner's workspace

## User access and personal data

User access is controlled by Diplek authentication service. This service is responsible for maintaining users' login credentials and personal data e.g. home address, telephone number and other sensitive information. For security reasons this data is stored in an encrypted form inside the platform database and is retrieved when the user tries to enter the platform. Along with private data, user access data is retrieved also, enabling the user to access specific platform components and services.

## USER GUIDANCE AND SUPPORT

Diplek offers besides the standard online and printed manual documentation, two additional ways of helping its users.

### Teacher Assistant

The large number of settings and services offered by the platform may prove counterproductive for the instructor user who just wants to do some simple tasks. That is why Diplek incorporates such a tool called the 'Teaching Assistant', which is available to all instructors (Figure 6. A).

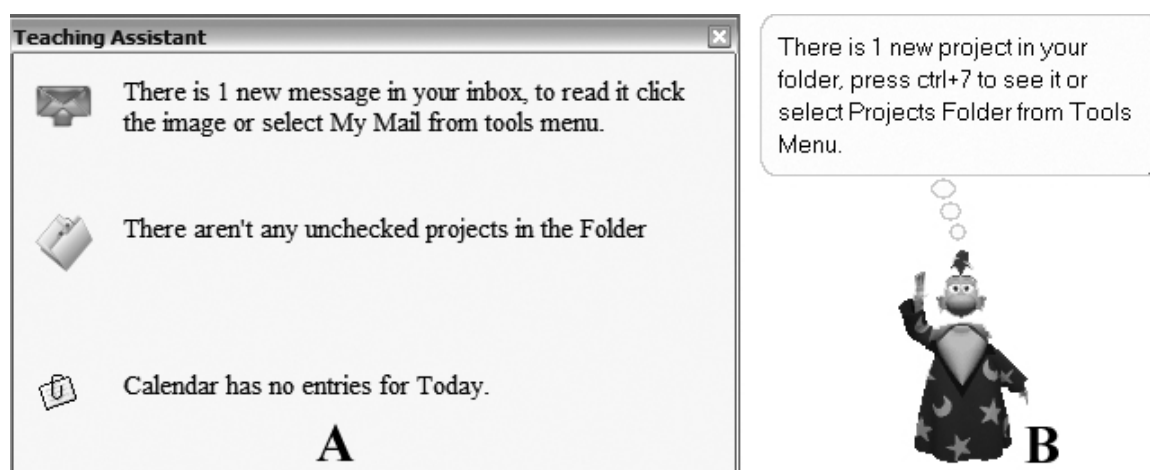


Figure 6. Screenshot – Teacher and Learner Assistants

This assistant provides information to the user about new messages, new project assignments and things to do from the calendar. User can enable and disable this feature with the click of a button so that it does not occupy screen space when not needed.

### Learner Assistant

In addition to the Teacher Assistant, a second assistant that has a friendlier look is available to the learner user. The Learner Assistant has the form of a wizard and shows up after a successful login (Figure 6. B). It provides information about date and time of day and informs the user about new messages, projects or tests assigned to him. This information comes with instructions of how to get access to the appropriate item so that user will not have to ask how to do that. The Learner Assistant character can be replaced with another one according to user's preferences and the educational domain.

### Two educational scenarios

Even though education is indented for the masses, the educational procedure does not work that way. The different learning style and ability of each individual have to be supported.

#### *Training people for using Web 2.0 Tools*

In order to fully understand the personalization level offered by the platform we shall discuss the following scenario. Mr John is an instructor working for an educational organization involved in adult education and training. He is assigned the task to instruct a group of fifteen school teachers in using web 2.0 tools in the educational procedure. He decides to use Diplek to provide modern educational facilities to these learners in his group. He creates a class and a course called 'Web 2.0'. He organizes the educational material into a presentation with ten units. Then he assigns that presentation to the whole group. Georgia is a learner who enrolls in Mr. John's 'Web 2.0' training course. Georgia has difficulty in understanding what web 2.0 tools are, and moreover on how they can be used since she has little experience with modern technologies and computers. This is where Diplek platform unties

the instructor's hands. Mr. John creates a new presentation with more introductory units that include examples on how computers are used in education. He then assigns this presentation only to Georgia. This way the rest of the group is progressing normally and Georgia has the chance to learn and keep up with the rest without slowing down the rest of the group. At the same time Georgia's weakness becomes known only to the instructor, thus allowing Georgia to express her misunderstandings more openly.

### ***Using Diplek in Life Long learning programs***

The "Greek Ministry of Agriculture" is running a European Union funded program for Life Long Learning courses in the area of Organic Farming. They currently offer a course called "Advances in organic farming and Biological products" which deals with modern techniques in farming without fertilizers and best practises for avoiding popular crop diseases. The course will be delivered asynchronously through Diplek LMS with the exception of two one hour sessions for a live presentation and question answering. Learners are farmers from European countries like Spain, France, Italy and Poland. The course instructors are two agronomists from Greece, Mr Giwrgos and Mr Leonidas, who have the necessary training and expertise in organic farming techniques. Additionally, a guest speaker from Cyprus will present an epidemiology study with the use of a Geographical Information System (GIS).

In order for the course to be ready on time, the two instructors decided to split it in two parts, each of which will be prepared using Diplek's presentation service. Fortunately there is some work already done by Mr Leonidas, but it is stored on a Moodle LMS that was previously used on a similar course. Mr Leonidas extracts that content from the Moodle LMS and imports it to the Diplek database adding metadata so that in future implementations of this course, the material will be ready to be transferred to a different learning platform if needed. The prepared material consists of technical reports, presentations of new agricultural machinery, pictures and precaution measures taken in other countries to avoid crop diseases. Most of the material is in video and presentation format.

Before the course is deployed, the two instructors take some time to collaborate with their Cypriot colleague and give him access to the course presentations in case he needs to add extra material. The collaboration is done with Diplek's communication services: live chat and messaging. In order to share some files needed for the course preparation, Diplek's Document Management Service is used. For the last day of the course, the three instructors have created a small project assignment for learners to write down their opinion on how organic farming can be helpful for their countries. Diplek's project management service is used to distribute that assignment to all learners.

During the course days, learners log into the platform and retrieve the necessary material. Most of the time, instructors are bombarded with questions. For answering these adequately, instructors have shared a document with frequently asked questions (FAQ) and when needed they add extra content to the course presentation.

### **Session recording service**

The session recording service is an innovative approach to logging learners' progress and learning achievements through a session. The use of this service provides the instructor with video feedback of a learner's session which consists of all learner actions, conversations, mouse movements, services used, educational material used, etc. The output is not the typical text entry in the database, but a video file which can be played in any video player.

Instructors can search for a learner's recording by selecting his/her class/group and username. They can then select the session recording they are interested in from a list of recordings ordered by date and time. Each learner's recording, starts from the moment of logging into the platform and ends when he/she logs out or closes the application. Instructors can view these recordings on a daily, weekly or monthly basis. By analyzing each learner's file, a general conclusion can be exported about the learner's progress. Viewing each learner's video recording is a time consuming job, but in some

cases it is necessary for the instructor to be able to track all learner's actions. Figure 7 shows a screenshot of the Session recorder settings window.

The use of this service is directly proportional to the processing power of the learner's workstation. Due to the large amount of data captured, a performance downgrade might occur on the learner's workstation. This can be avoided by using a more powerful processor. The session recording service is by default disabled so that instructors can enable it on certain users and on specific time, when it is actually needed.

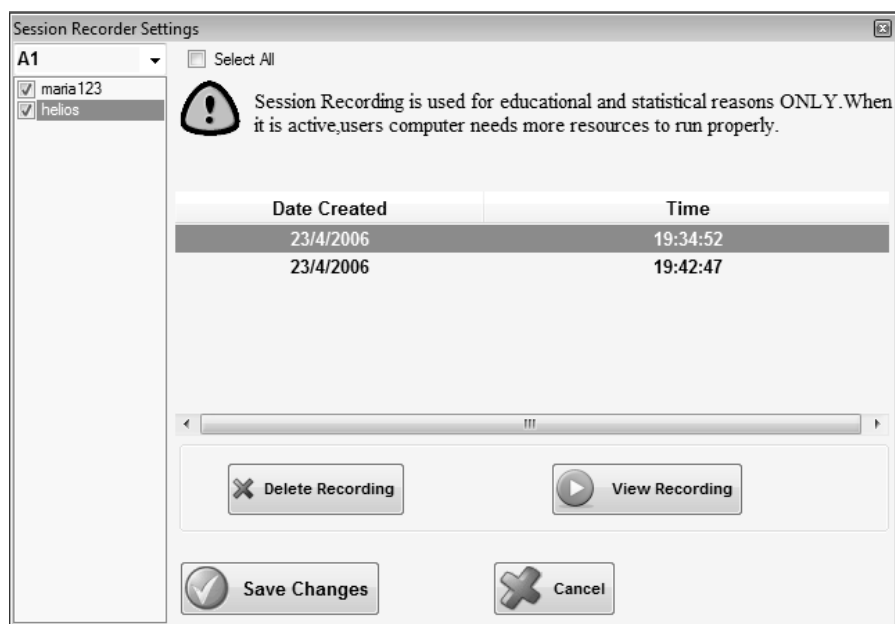


Figure 7. Screenshot - Session recorder settings

In addition to the session recording service, Diplek keeps text logs of all user actions. These logs are stored into Diplek's database and can be retrieved by instructors and administrators. Each entry in the log consists of the following information: username, location of user (IP address), date and time, service that originated it, action and any extra information. Instructors can filter these data by date, user or service and then export it to a .csv file, for further processing outside the platform. A good practice would suggest analysis of these data with the use of a graphical tool. A further analysis of log data could lead to results like LOs usage, service usage and user's preferences in LOs and activities.

## FUTURE RESEARCH DIRECTIONS

LMSs have overcome the early stages of a trend and are now a major part of what we call educational revolution. The deployment of a LMS in an organization should be done in respect to the existing infrastructure. It is more important to have a learning platform that smoothly integrates with all other organization's supporting tools (Customer Relation Management tools, Enterprise and Resource Management tools, etc.) rather than having an isolated LMS on the organization's network. This could be achieved by using a Service Oriented Architecture for developing LMSs where only the necessary services are exposed to the network and are made available to the rest of the organization's infrastructure.

In order for people to be able to choose the right course for them, a global search engine could be used for all supported LMSs. This search engine could be used not only for searching with keywords for courses but for searching with terms like cognitive level, difficulty level, discipline area, etc. This would be a great improvement for people seeking for Life Long Learning opportunities since all this information will not be scattered around, but gathered and presented by a search engine where it is

easily accessed. This of course requires the use of compatible metadata from all LMSs taking part and the exposure of the necessary information.

As with any other software, Diplek needs to keep up with the rapid developments in the field of modern ICT. The current version of Diplek enables instructors to maintain an easy to use learning environment for their learners' by customizing the course presentations and platform services according to each users needs. This customization is currently done by hand. In a future version of Diplek, a smart agent could be used to customize the presentation based on rules and conditions set by the instructor. For maintaining the simplicity of the platform, another agent will inform and consult the instructor about which learners need more attention and propose changes for the current course and presentation. In order for the agent to be efficient, data mining techniques (Cobos et al., 2007) could be used for extracting user's data from log files.

The use of smart agents (Alonso, Kudenko & Kazakov, 2003) should not be limited in just informing the instructor but the learner as well. The currently available virtual assistant can be re programmed to offer advice to learners about what courses and presentations they should attend for better understanding of the course. This advice of course should be based on each user's profile and personal goals stated by the learner or the instructor at the beginning of the course.

On the current version of Diplek platform, the profile management service is based on data entered by the learner at the beginning of the course. These data should be updated during the course when a learner finishes a learning unit, completes a test or an assignment. That is the basis for developing a new dynamic profile service. Instructors can use this service to keep track of their learner's achievements and progress during the course. Also feedback can be sent to smart agents for proposing new units and presentations to the learner user.

Diplek's GUI is based on a standard theme. The fact that the platform might be used by people with disabilities requires that Diplek supports different themes for each type of user. So, a proposed expansion for the platform would be the support of custom themes.

Currently, there is an ongoing evaluation of the Diplek platform in the context of EGIS+ project which is a pilot program based on the Leonardo funded program "Transfer of Innovation". The objectives of the project are to further develop results from the previous Leonardo Pilot Project E-GIS (Sponberg, Ossiannilsson, Johansen & Pilesjö, 2003). The results of this evaluation will be available in spring of 2010 when the project ends. Diplek is also used in a postgraduate thesis project involving teaching Geography in elementary school students with the use of ICT. The platform is deployed experimentally in an elementary school and a group of students is using it, under the supervision of the teacher, to learn about phenomena like day-night, the 4 seasons, the tides, etc. The results and feedback of this evaluation are also expected by spring 2010.

## **CONCLUSION**

Diplek is a service oriented LMS that was designed to help novice instructors to get involved in e-learning technologies. Using Diplek unties the hands of instructors seeking new innovative ways of keeping control of the class and allows them to manage efficiently, the educational process. Most of Diplek services are focused on learner's needs and requirements. Diplek user interface is consistent with common software engineering and usability rules for developing educational software.

Nowadays, educators have access to many modern tools and services that can be used to enhance teaching and learning experience. Diplek is one of them, and it can be used along with other platforms available. The platform was designed to be used in cases where a simple and cost effective solution would be desirable and most preferable.



Diplek as mentioned earlier is currently under evaluation. The expected feedback from this process will be taken under consideration in order to release the next version of the platform with changes and features requested by evaluators and users.

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