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e-Learning Environments

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1 Introduction

This document presents four environments recognised by the project consortium as possible solutions for providing the basis for the DigiWater digital e-learning platform. Two types of environments were studied: Content Management Systems (CMSs) and Learning Management Systems (LMSs).

- CMS - Content Management Systems are in the most basic e-learning platforms and allow dynamic websites to be generated. The objective of these programmes is the creation and management of online information (texts, images, graphics, videos, sounds, etc.)
- LMS - Learning Management Systems come from CMSs and provide an environment which makes Web updating, maintenance and amplification possible with the collaboration of multiple users.

In the first category, the WordPress CMS and the Joomla CMS are included, while in the second category, the Moodle LMS and the Blackboard LMS are discussed (see Table 1). The two CMS are examined from the perspective of becoming an LMS with the use of add-ons.

E-Learning Environments		
1.		Moodle Learning Management System (LMS)
2.		Blackboard LMS
3.		WordPress Content Management System (CMS) with LMS Plugins

4.	 Joomla! TM	Joomla CMS with LMS Plugins
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Table 1: E-Learning Environments studied

For each environment, a brief overall description is given, followed by the functionalities offered. The languages supported and worldwide numbers of users are presented. Technical requirements and specifications for user registration and access are explained. The types of user accounts is also an important aspect included. Then more general but still important features are examined, such as Security, Privacy, and Accessibility. Finally, the pros and cons are discussed.

In the end, five important points concerning the specific aims of DigiWater are addressed, as follows:

- Is the environment open-source?
- Can the environment integrate h5p?
- Can the environment host videos and simulators (software)?
- Evaluation procedures: is there potential for automated digital assessment methods within the environment?
- Can the environment integrate virtual labs?

The differences between LMS and CMS are also examined.

2 Important Functionality

The following list briefly presents functionality recognised as important on eLearning environments in general, but also specifically for the needs of the DigiWater project:

- Course creation
- Course enrollments
- Track students progress
- Grade books, Grading schemes
- Evaluation & Assessment activities (e.g., quizzes, assignments)
- Calendar

- Easy back-up, exports and import of courses
- Detailed reporting and logs of students activity and overall statistics
- Learning paths creation and management
- Peer and self-assessment

The following list briefly presents functionality recognised as important on all platforms and environments in general, and also specifically for the needs of the [DigiWater](#) project:

- Content Creation & Editing
- Management of user roles and permissions
- Collaboration tools and activities
- Multiple methods of communication: email, threaded discussions, real-time "live" online discussions
- Multimedia integration (images, videos, etc.)
- Multilingual capability
- Accessibility
- Security & Privacy (incl. GDPR)
- File and Data management

3 E-Learning Environments

Moodle LMS	
Brief Overall Description:	Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments.
Functionality offered:	<ul style="list-style-type: none"> ● Modern easy to use interface ● Personalised Dashboard ● Collaborative tools and activities ● All-in-one calendar ● Convenient file management ● Simple and intuitive text editor ● Track progress ● Customisable site design and layout ● Multilingual capability

	<ul style="list-style-type: none"> ● Bulk course creation and easy backup ● Manage user roles and permissions ● Support open standards ● Simple plugin Management ● Detailed reporting and logs ● Direct learning paths ● Encourage collaboration ● Embed external resources ● Multimedia integration ● Group Management ● Peer and self-assessment ● Integrated Badges
Supported Languages:	<ul style="list-style-type: none"> ● Over 100 language packs are available for an administrator to install on Moodle site
Users Worldwide:	<ul style="list-style-type: none"> ● Moodle is trusted by institutions and organisations large and small, including Shell, London School of Economics, State University of New York, Microsoft and the Open University. Moodle's worldwide numbers of 251 million users¹, 33 million courses, 173 thousand sites, in 242 countries, across academic and enterprise level usage make it the world's most widely used learning platform. ● Source: https://docs.moodle.org/310/en/About_Moodle, https://stats.moodle.org/
Technical Requirements:	<ul style="list-style-type: none"> ● Database (MySQL, MariaDB) ● hosting server
User registration and access:	<p>Users may use Moodle as guests, or they might need an account (depending on whether the course is open)</p>
Types of user accounts:	<ul style="list-style-type: none"> ● Admin - Admin users will be assigned the default legacy admin role in the system (site) context in Moodle ● Course Creator - Course Creators will be assigned the default legacy course creator role in the system (site) context. Course creators are intended to create courses only. Once the creator makes a new course, they are usually enrolled into the course with a default creator role. ● Teacher - Users who were teachers will be assigned the default legacy teacher role (or non-editing teacher role) in all courses they were a teacher.

	<ul style="list-style-type: none"> ● Non-editing teacher - Able within a course to view and grade students work. May not alter or delete any of the activities or resources. This role might typically be given to a classroom assistant, for example. ● Student - Users who were students will be assigned the default student role in all courses they are students. ● Guest - There will still be a single guest user with no default role at the site level. For each course that allows guest access, the guest role will be assigned to the guest user for that course context. The guest control for the course will be modified from three to two options (guests always need to enter the enrolment key - on/off). This setting is checked as now to force guests to enter a key. ● Authenticated user - When a user logs in, they are automatically assigned the role of an authenticated user. A user will have additional roles as well as the established user role according to where they are in Moodle, such as a student in a course. By default, authenticated users have permission to edit their profile, send messages, blog and do other things outside of courses.
Security and Privacy:	<ul style="list-style-type: none"> ● It is designed to provide security and privacy ● Additional plugins for security and privacy ● Secure authentication ● Regular security updates: Moodle is regularly updated with the latest security patches to help ensure your Moodle site is secure. ● Teach and share in a private space only you and your class can access.
Accessibility:	<p>Moodle is designed to be accessible. Also, Moodle has some plugins to address accessibility issues.</p> <p>With regards to how Moodle should present its content, the WCAG 2.1 guidelines are followed.</p>
Pros:	<ul style="list-style-type: none"> ● It is open-source ● Great community ● Customizable ● Widely available ● Sell content online ● Familiar

	<ul style="list-style-type: none"> ● It has loads of content available ● It allows for many different content formats to be uploaded and available for use by the students and the instructor ● Communication between the instructor and students ● Communication between students
Is it open-source?	Yes, it can be set up and used for free
Can it integrate h5p? https://h5p.org/getting-started	Yes. You can install h5p as a plugin for Moodle, and then you can use it. In addition, since Moodle 3.8, uploading and using H5P content into courses will be done natively: users will be able to create, share and reuse H5P interactive content without the need to install any extensions.
Can it host videos and simulators (software) (either links to the simulators or integrated into the platform, e.g. Moodle LTI)?	<p>Yes. You can add the link of the video or software, or you can embed the videos in the Moodle environment. Also, you can host videos and simulators through custom code or plugins and with iframes. In addition, Moodle supports LTI (Learning Tools Interoperability). LTI is a specification developed by IMS Global Learning Consortium. It establishes a standard way of integrating rich learning applications, called tools (delivered by tool providers), with platforms such as learning management systems, called tool consumers.</p> <p>For non-web software: executable application files should be downloaded from within the environment and installed locally on the learner's device. Consideration needs to be taken on the learning methodology and where the software will be used within the context of a course.</p>
Is there a "Hangout Session" or similar functionality?	Yes. You can add a Google Hangout button to the Moodle website. There is also the default Moodle chat and forums that can be added to any course.
Evaluation procedures: is there potential for automated digital assessment methods?	Yes. One example being the auto-graded quizzes. There are many types of questions that can be included in auto-graded activities.
Can it integrate virtual labs?	<p>There is the possibility to integrate the "TeamViewer" software into the course so that students can remotely connect to a remote machine.</p> <p>There is also the potential of custom code or plugins that UCY</p>

	can undertake.
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Table 2: Moodle LMS

Blackboard LMS	
Brief Overall Description:	<p>Blackboard Learn is an application for online teaching, learning, community building, and knowledge sharing.</p> <p>Any theory or model for teaching an online course can be applied as Blackboard Learn is open, flexible, and centred on student achievement. In addition, blackboard supports education from K-12 and higher education to adult learning and workplace training.</p> <p>With Blackboard Learn, teaching online shares many similarities with teaching in the face-to-face (f2f) classroom.</p>
Functionality offered:	<ul style="list-style-type: none"> ● Collaborate Integration ● Group Management ● Grading Enhancements ● Student Preview ● SafeAssign ● Enhanced Cloud Profile ● Portfolio ● Social Learning ● Data Management ● Blackboard Drive ● Course Enrolments ● Active Collaboration ● Calendar ● Content Editor ● Retention Centre ● Dynamic Content
Technical Requirements:	<ul style="list-style-type: none"> ● Database ● Hosting server

User registration and access:	Users may use Blackboard as guests, or they might need an account (depending on whether the course is open)
Types of user accounts:	<ul style="list-style-type: none"> ● Students can view their information, such as grades, assignments, and attendance history. ● Parents can view information about themselves and their children, such as grades, assignments, and attendance history. Most messages are sent to the parent account instead of the student account. ● Staff members can view the Accounts tab, but the information is limited to only the students and parents in their class. If the staff member is not a teacher and has no students, they will be restricted to viewing only their account. A staff member may only send messages to parents, students, and other staff members (depending on district permissions). Staff members have access to the Contact Report, Message Tracking, Recipient Tracking, and Grade Uploads reports. ● Observers can view student, parent, and staff accounts listed at their school location but cannot make changes to any information. Observers at the district level will view all students, parents, and staff information within the district. Observers have the same report viewing privileges as school administrators. Observer accounts are typically used for school counsellors who need to view student data without making changes. ● Community Members can receive messages and announcements. A community member cannot view any reports and cannot send any messages. Community Member accounts are ideal for local news contacts that need to receive messages and view school announcements. ● School Administrators can only look up accounts that exist within their school. They can send messages, but message viewing is limited to those sent from their school. In addition, they cannot see messages that are sent from the district. A school administrator may use all reports available on the system, but the reports will be limited to information regarding their school. ● District Administrators can look up accounts at any school within the district. A district administrator has the most privileges of all the account types. They have

	<p>the ability to send messages, view messages, and make changes to settings. A district administrator can also use all of the reports available on the system and view information for any school in the district.</p> <ul style="list-style-type: none"> ● Attendance Secretaries can only view students and parents at their schools. They may send messages to parents, students, and staff at their school. Attendance secretaries have access to the Contact, Message Tracking, Recipient Tracking, System Usage, and School reports. ● Principals can view all roles at their school. They can send messages, but message viewing is limited to those sent from their school. They can't see messages that are sent from the district. A principal may use all reports available on the system, but the reports are limited to information regarding their school. ● Superintendents can look up accounts at any school within the district. In addition, they can send and view messages. A superintendent can also use many of the reports available on the system. ● Teachers can view the Accounts tab, but it is limited to only the students and parents in their class. If they have no students, they will be restricted to viewing only their accounts. A teacher can only send messages to parents, students, and other staff members (depending on district permissions). Teachers can access the Contact Report, Message Tracking, Recipient Tracking, and Grade Upload reports.
Security and Privacy:	It is designed to provide security and privacy
Accessibility:	Blackboard is designed to be accessible. Also, Blackboard has some plugins for accessibility issues.
Cons:	<ul style="list-style-type: none"> ● Interface isn't very modern ● Slow page load times (depending on content) ● It does not work good enough with mobile phones ● Blackboard Collaborate covers no Classroom Training Management attributes. This needs to be improved to satisfy users' Classroom Training Management requirements, considering that its competitors cover an average of 74% of attributes for this module,

	<p>representing a significant disadvantage for Blackboard Collaborate.</p> <ul style="list-style-type: none"> ● Blackboard Collaborate supports 51% of Custom Content Authoring/Publishing Tools features. Other LMS software packages on the market average 75% coverage in this module, meaning the BlackBoard Inc ● Blackboard Collaborate covers none of the Communication and collaboration attributes.
Pros:	<ul style="list-style-type: none"> ● Good for organizing content ● Good platform to take tests and quizzes ● Choice of layout options to fit different styles of courses ● Clear communication of assignments ● Easy to use course navigation ● Provides HTML quality course content that is easily retrievable and viewable ● Provides multiple methods of communication: email, threaded discussions, real-time "live" online discussions, and a grade portal. ● Allows facilitators multiple grading methods or providing feedback: threaded discussions, rubric scoring, personal comments, inline viewer, or download/upload attachments.
Is it open-source?	It is a paid software
Can it integrate h5p? https://h5p.org/getting-started	<ul style="list-style-type: none"> ● Yes. 5P provides very tight integration with Blackboard through H5P.com. With H5P.com, content may be created from within Blackboard
Can it host videos and simulators (software) (either links to the simulators or integrated into the platform, e.g. Moodle LTI)?	<p>Yes.</p> <p>For web/online software: You can add the link of the video or software, or you have the ability to embed the videos in the Blackboard environment. Also, there is the possibility to host videos and simulators through plugins or with iframes. In addition, Blackboard supports LTI (Learning Tools Interoperability). LTI is a specification developed by IMS Global Learning Consortium. It establishes a standard way of integrating rich learning applications, called tools (delivered by</p>

	tool providers), with platforms such as learning management systems, called tool consumers.
Is there a “Hangout Session” or similar functionality?	You can use google meet for blackboard
Evaluation procedures: is there potential for automated digital assessment methods?	Yes. Automated grade methods for students
Can it integrate virtual labs?	Yes, with custom code or iframe Web conferencing through blackboard.

Table 3: Blackboard LMS

WordPress CMS	
Brief Overall Description:	WordPress (WP, WordPress.org) is a free and open-source content management system (CMS) written in PHP and paired with a MySQL or MariaDB database. WordPress was originally created as a blog-publishing system but has evolved to support other web content types, including more traditional mailing lists and forums, media galleries, membership sites, learning management systems (LMS) and online stores. More than 60 million websites use WordPress.
Functionality offered:	<ul style="list-style-type: none"> ● Moderating – Keep track of comments, users, roles, permissions, etc. ● Full User System – Allow newsletter users, admins, reviewers, etc. ● Integrated RSS feeds APIs and preset plugins. ● Maintaining Stability – WordPress is designed for non-technical maintenance. Therefore, the large community extensively tests core updates before release. ● It's generally simple to import data from multiple platforms. ● Dynamic generation of URLs and overall database structure.

	<ul style="list-style-type: none"> ● Drag-and-drop functionality in the backend to allow for easy customization. ● Variety of supported languages, typography, and content editors. ● Access revised versions of posts and old content. ● Easily publish content, pages, and media. ● Share a single backend among multiple WordPress sites.
WordPress as an LMS	<p>eLearning functionality can be offered through plugins, such as the LearnPress plugin.</p> <p>LearnPress:</p> <ul style="list-style-type: none"> ● LearnPress is a comprehensive WordPress LMS Plugin for WordPress (like a “WordPress Moodle”) ● easily create & sell courses online ● course curriculum can be made with lessons & quizzes, which can be managed with an easy-to-use user interface ● LearnPress is free ● is lightweight, powerful with lots of add-ons ● Advanced functionality requires the paid version through the “Education WP Theme”, “Coaching WordPress Theme”, & “LMS WordPress Theme”. ● LEARNPRESS TUTORIAL videos offered for free ● work with any WordPress themes. ● Ability to export courses and import them to other websites that are also using LearnPress ● Create a course, share it, manage it, get statistics about the number of students, its trend, etc. ● Communicate with your student or instructor via the WordPress forum ● Add-ons are used to provide extra features. Many additional features exist in Moodle, e.g. “assignments”, need extra add-ons, a different add-on for each. Many add-ons are paid, like the one for assignments. ● Translated in 8 languages ● LearnPress is actively developed ● Active installations (of free version):100,000+ ● Source: https://wordpress.org/plugins/learnpress/
Technical Requirements:	Database and server to host the platform.

User registration and access:	Users access on the admin. In some cases, the users may access the platform without an account or may be required to register and obtain an account.
Types of user accounts:	<ul style="list-style-type: none"> ● Super Admin – somebody with access to the site network administration features and all other features. ● Administrator – somebody who has access to all the administration features within a single site. ● Editor – somebody who can publish and manage posts, including the posts of other users. ● Author – somebody who can publish and manage their posts. ● Contributor – somebody who can write and manage their posts but cannot publish them. ● Subscriber – somebody who can only manage their profile.
Security and Privacy:	Yes. You can add plugins for enhancing security and privacy; nevertheless, it is designed to provide security and privacy
Cons:	<ul style="list-style-type: none"> ● Since WordPress is so popular, it becomes a central target for hackers. The core and plugins are commonly exploited and require fairly frequent updates to remain secure. ● Some features like custom post types (content types) may become complex and require some training. ● Scalability often becomes an issue with very large sites. ● WordPress is not built around performance; therefore, extended plugins or coding may be required to improve overall performance.
Pros:	<ul style="list-style-type: none"> ● The code and template structure allows for custom themes built around your exact needs. ● Search engine optimization can be integrated within custom themes from popular plugins. In addition, Google has indicated support for WordPress sites as crawl bots can easily index these sites. ● WordPress has a very large community that improves the structure, styling, and functionality of WordPress daily. They also keep the community secure from noted vulnerabilities. ● After WordPress is set up, styled, and configured properly, it makes content updates efficient and

	<p>straightforward compared to other CMS platforms.</p> <ul style="list-style-type: none"> ● Blogging: WordPress was originally meant for blogging and remained a top CMS for simplified blogging. ● Managing users is essential for larger websites. Through WordPress, we can control users, roles and specific permissions. ● Provides an extensive number of plugins and possibilities for functionality improvements.
Accessibility:	WordPress is designed to be accessible. Also, WordPress has some plugins for accessibility issues.
Is it open-source?	Yes
Can it integrate h5p? https://h5p.org/getting-started	Yes, you can install h5p through WordPress plugins
Can it host videos and simulators (software) (either links to the simulators or integrated into the platform, e.g. Moodle LTI)?	Yes, you can host videos and simulators in WordPress through iframe or custom code. Also, there are plugins such as the LTI connector for WordPress.
Is there a “Hangout Session” or similar functionality?	Yes. You have the ability to embed a Hangout Session in WordPress. LearnPress also integrates with WordPress default forum.
Evaluation procedures: is there potential for automated digital assessment methods?	<p>Yes. WordPress has plugins that are available to install for this purpose.</p> <p>Add-ons compatible with LearnPress are available to use.</p>
Can it integrate virtual labs?	<p>There is the possibility to integrate the “TeamViewer” software into the course so that students can remotely connect to a remote machine.</p> <p>There is also the potential of custom code or plugins. UCY can undertake this task.</p>

Table 4: WordPress CMS

Joomla CMS	
Brief Overall Description:	Joomla! is one of the world's most popular software packages. It is used to build, organise, manage and publish content for small businesses, governments, nonprofits and large organisations worldwide. Joomla offers a great opportunity to grow your business by building websites and applications.
Functionality offered (bullet list):	<ul style="list-style-type: none"> ● User Management ● Media Manager ● Banner Management ● Contact Management ● Search ● Web Link Management ● Content Management ● Syndication and Newsfeed Management ● Template Management ● Integrated Help System ● System Features ● Web Services ● Powerful Extensibility
Joomla as an LMS	<p>There are extensions for Joomla to become LMS with limited functionality (free or paid)</p> <p>Examples:</p> <ul style="list-style-type: none"> ● https://www.joomlms.com/ ● https://www.joomshaper.com/joomla-extensions/sp-lms
Technical Requirements:	Database and a webserver to host the platform.
User registration and access:	Users may use Joomla with or without accounts.

Types of user accounts:	<ul style="list-style-type: none">● Registered - This group allows the user to log in to the Frontend interface. Registered users can't contribute content, but this may allow them access to other areas, like a forum or download section, if your site has one.● Author - This group allows a user to post content, usually via a link in the User Menu. They can submit new content, select options to show the item on the front page and select dates for publishing, but they cannot directly publish any content. When an Author level user submits content, they receive the message, "Thanks for your submission. Your submission will now be reviewed before being posted to the site." They can edit only their articles but only when that article has been published and is visible.● Editor - This group allows users to post and edit any (not just their own) content item from the Frontend. They can also edit the content that has not been published. For example, suppose your site uses the default installation's menu option "News", a Table List – Content Section type. In that case, Editors will see unpublished articles in the list that they can select for editing. In contrast, an Author or Public (unregistered) user will not even see the unpublished items in the list. Still, Editor users cannot publish or change the publishing status of any articles, even their own.● Publisher - This group allows users to post, edit and publish any (not just their own) content item from the Front-end. Publishers can review all articles, edit and change publishing options, but they can also determine when an article is ready for publication, making it visible to Registered, Author and the Unregistered Public (depending on what visibility was chosen in the article, of course!)● Manager - This group allows access to content creation and other system information from the Backend. Think of Manager users as Publishers with Backend access. They can log in through the Administrator interface, but their rights and access are generally restricted to content management. They can create or edit any content, access to some Backend only features like adding, deleting and editing Sections and Categories, editing the Front Page and Menus. Still, they don't have any access to the "Mechanics" of Joomla, like user
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	<p>management or the ability to install components or modules. Note that if a Manager logs in through the Frontend interface, they're treated just like a Publisher, with the same rights and access.</p> <ul style="list-style-type: none"> ● Administrator - This group allows access to most administration functions. An Administrator user has all the privileges on the back end of a Manager, but they also have access to set options on and install/delete components, modules and plugins, User Manager access and can view the site statistics. However, they cannot change, edit or install Site Templates, or make any changes to the site Global configuration options. On login through the Frontend, they are treated as Publishers, just like the Manager users. Interestingly, when an Administrator accesses the User Manager list, they will see all users at their access level or below; in other words, they can modify any user EXCEPT a Super Administrator they will not even see Super Administrator accounts in the list! Also, they cannot create additional Super Administrator level accounts, only a Super Admin can do that. ● Super Administrator - This group allows access to all administration functions. Only another Super Administrator can create or edit a Super Administrator user account. Full access to ALL AREAS is given to Super Administrators, and once created, they cannot be easily deleted. It might not be obvious, but you have to change the user's group to something other than Super Administrator first. Then you can delete them.
Security and Privacy:	It is designed to provide security and privacy and has extensions for security and privacy.
Accessibility:	Joomla is designed to be accessible. Also, Joomla has plugins for accessibility issues.
Cons:	<ul style="list-style-type: none"> ● There are only a few additional modules available ● It can place a greater demand on your server resources. ● You must navigate through paid plugins. ● Adjustment options are rather limited. ● There can be some compatibility issues.

Pros:	<ul style="list-style-type: none"> ● It is an open-source platform. ● It is capable of supporting e-commerce. ● It is extremely easy to edit. ● It is still useful for developers as well. ● There is plenty of support available. ● It's easy to take advantage of internet marketing strategies.
Is it open-source?	Yes
Can it integrate h5p? https://h5p.org/getting-started	Yes, there is an h5p Joomla extension
Can it host videos and simulators (software) (either links to the simulators or integrated into the platform, e.g. Moodle LTI)?	Yes, you can add videos and simulators through iframe or custom code.
Is there a “Hangout Session” or similar functionality?	Yes. There is an option to display google hangouts launcher that allows instant messaging video chat sms, and voip features
Evaluation procedures: is there potential for automated digital assessment methods?	Yes. You have this ability with some extensions like Joomla! Quiz Deluxe Component. But it's not free.
Can it integrate virtual labs?	Yes, through custom code or iframes.

Table 5: Joomla CMS

4 Comparison

Following the above study, we present the following comparison between a CMS and an LMS in regards to the [DigiWater](#) digital e-learning platform:

- LMS specialises in providing e-learning, adjusting to teaching needs, and providing flexible solutions to accommodate all teaching methodologies.
- Learning-related functionality, including course creation and management, evaluation methods, student enrollment, grading book, and more, are incorporated using add-ons or plugins (free or paid) in a CMS.
- The learners can follow-up and evaluate the material, through the interactive tools that offer the LMS.
- A CMS is not explicitly designed to be used for e-Learning.
- Not all functionalities of an LMS are offered, even with plugins or add-ons on a CMS.
- In LMS platforms interaction with experts on any area is possible, without it mattering where they are (for example by means of videoconference).
- Students are more familiar with the well-known LMS such as Moodle and Blackboard.
- Specialised tutorials, forums, and help setting up and using all the learning features are offered in LMS.
- LMS offer the functions to the educator-learner and learner-learner communicate each other improving with incorporated the communication tools.
- CMS is a more passive application, it's mostly used to view documents. Whereas LMS is an application where learners are motivated to be interactive with the system. Learners are able to try, for example a quiz. Creators are able to create a quiz and track progress of learners.

Additionally, the following list is summarising the comparison between the two LMS studied, Moodle and Blackboard:

- They can both integrate H5P.
- They both offer important eLearning functionalities.
- Moodle as well as Blackboard gives you the feature of sharing and uploading Interactive Courses on the system
- Moodle is used by 251 million users in 242 countries across both academic and enterprise levels. In addition, blackboard is used by over 100 million users.
- Many language packs are available in both
- Moodle UI offers a more customisable site design and layout
- Moodle lets author courses using certain tools but Blackboard has to outsource this part of course creation
- Moodle UI is more responsive, i.e., customised to different screen sizes.

- Moodle promotes student-centred learning which is fast becoming popular owing to its user-centric approach.
- Moodle has a well designed architecture, so its faster as compared to Blackboard, where students have faced problems while loading pages.
- Blackboard is paid, while Moodle is free.
- Moodle has full-fledged integration with Google applications but Blackboard lacks on this front
- Moodle is known for its modular framework which allows any number of users, depending on the chosen hosting. However, Blackboard has a limited number of users which becomes a setback for larger institutes.

UCY suggestion is the *Moodle LMS environment*.

5 Videos, Simulators, Software & Tools

The following table presents examples, links, videos, simulators and other software and tools, and virtual labs to be included or connected within the e-learning platform.

Simulators :	
Videos:	
Other software/tools:	
Virtual labs:	

Table 6: Videos, Simulators, Software & Tools

6 Accessibility

The aim of integrating accessibility requirements is to give the ability to the platforms to offer accessible and inclusive information for all and lift this task from the tutor's responsibilities by allocating it to the supporting technology and tools. In addition, the target is to remove any possible barriers and overcome the disability or diversity by offering accessible e-learning environments to all (social model of disability [1]).

Both the platforms and the material should be inclusive and accessible to the largest degree possible regarding the WCAG 2.1 (AA). Some aspects of accessible design to be considered include:

- Providing good contrast between background and foreground.
- Be mindful of the experience on different devices.
- Considering font size and type.
- Offering accessible links (i.e. there is both a clickable link and direct URL).
- Alternative text for images.
- Closed captions for videos/transcripts for videos.
- Avoiding embedding text in images.
- Correct use of HTML tags.
- Supporting navigating pages using only a keyboard.
- Using labels, perhaps even help descriptions where needed, with form inputs.
- Using appropriate page titles.
- Using ARIA attributes to support dynamic interaction.

7 Non-Functional Requirements

- **Usability Requirements**

A user-friendly and interactive interface must be offered to provide a better user experience to all users and maximise the platform's usability. All the features provided should be easy to use, with to-the-point keywords and descriptive instructions. All menu links and buttons must be easy to find. The design should be simple, minimal and appropriate for the specific platform's purposes.

- **Performance Requirements**

All features should function properly without any user-perceived delays.

- **Privacy and Security Requirements**

All data collected will be processed in a manner that ensures appropriate security, including protection against unauthorised or unlawful processing and accidental loss, using appropriate technical or organisational measures.

The platform should be complying with the GDPR. All data shall be processed lawfully, fairly, and transparently in relation to the data subject (the individual

associated with them). Furthermore, the platform will ensure a level of security appropriate to the risk assessed as existing.

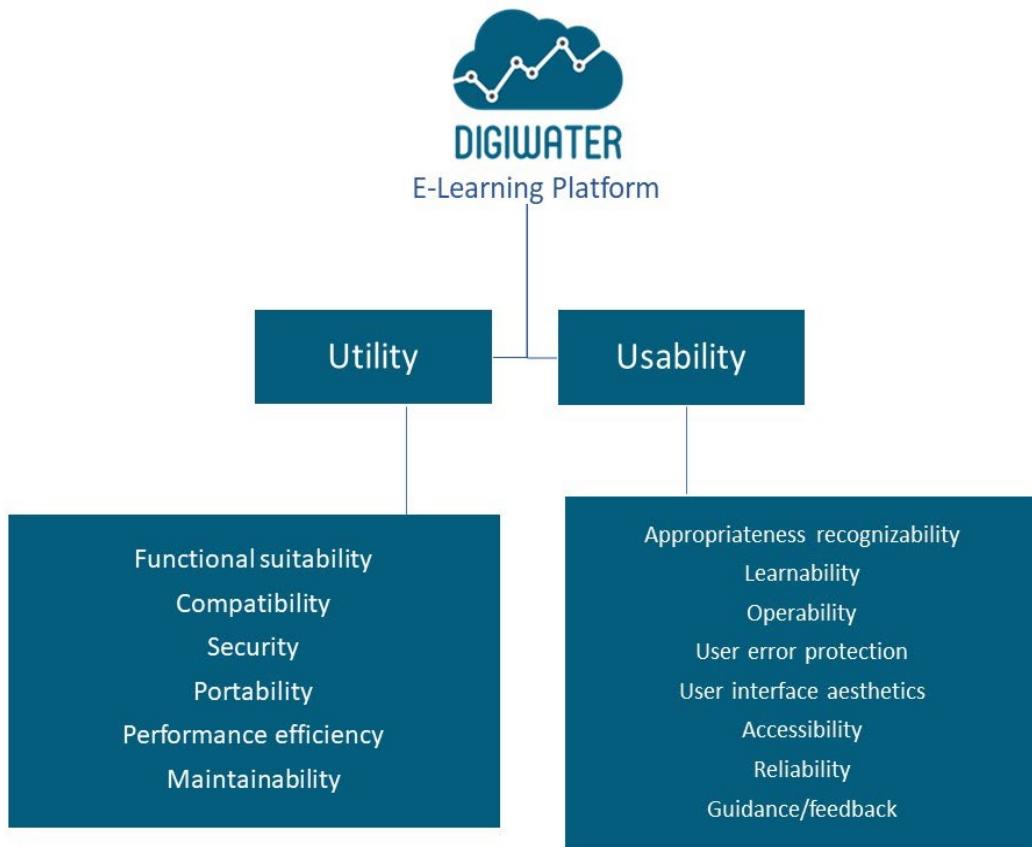


Figure 1. DigiWater E-Learning Platform

8 E-Learning Platform Architecture - Diagrams

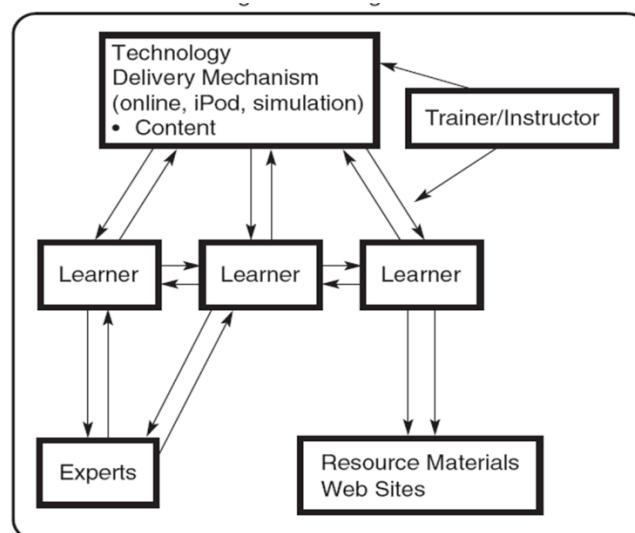


Figure 2. E-Learning Environment



Figure 3. Platform Features of E-Learning

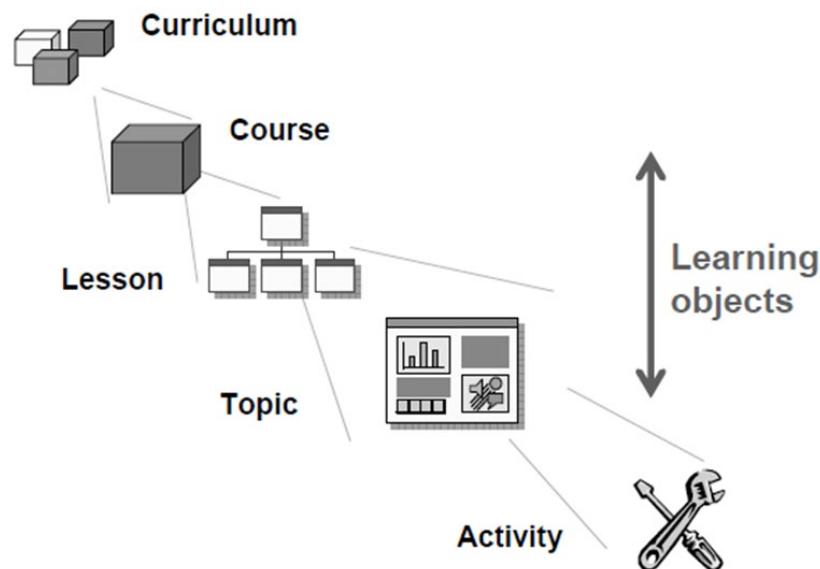


Figure 4. Design courses of E-Learning Platform

9 References

- MOODLE LMS:
 - https://docs.moodle.org/310/en/Interactive_Content_-_H5P_activity
 - https://docs.moodle.org/310/en/LTI_and_Moodle
 - <https://docs.moodle.org/dev/Accessibility>
 - <https://www.paradisosolutions.com/blog/google-hangouts-moodle-integration/>
 - <https://moodle.org/mod/forum/discuss.php?d=241967>
 - <https://www.beamstacks.com/blog/moodle-advantages-and-disadvantages-learning-system/>
 - <https://comparecamp.com/moodle-review-pricing-pros-cons-features/>
 - <https://www.trustradius.com/products/moodle/reviews?qs=pros-and-cons>
 - https://docs.moodle.org/19/en/Authenticated_user_role
 - https://docs.moodle.org/310/en/Roles_and_permissions
 - https://docs.moodle.org/310/en/Assign_roles
 - https://docs.moodle.org/310/en/LTI_and_Moodle
 - <https://www.paradisosolutions.com/blog/google-hangouts-moodle-integration/>
 - <https://h5p.org/moodle>
 - https://moodle.org/plugins/mod_vpl
 - <https://docs.moodle.org/310/en/Features>
 - <https://moodle.com/lms/features/>
- WordPress:
 - <https://h5p.org/wordpress>
 - <http://www.spvsoftwareproducts.com/php/wordpress-lti/>
 - <https://www.wpbeginner.com/wp-tutorials/how-to-embed-a-live-google-hangout-session-in-wordpress/>
 - <https://wordpress.org/plugins/moolamojo/>
 - <https://www.sitepoint.com/e-learning-plugins-for-wordpress/>
 - <https://h5p.org/documentation/setup/wordpress>
 - <https://el.wordpress.org/plugins/h5p/>
 - <https://mediag.com/blog/the-world-of-wordpress/>
 - <https://kinsta.com/blog/is-wordpress-secure/>
 - <https://wordpress.org/support/article/wordpress-privacy/>
 - <https://wordpress.org/support/article/roles-and-capabilities/>
 - https://www.bluehost.com/resources/what-wordpress-user-roles-are-and-how-to-manage-them-for-your-website/?utm_source=google&utm_medium=genericsearch&gclid=Cj0KCQiAmL-ABhDFARIsAKywVaesifvQhMiw5vi6QvVpcnhG4bBA3bpCG68974f5VNHDLeV_gzUU_caApYoEALw_wcB&gclsrc=aw.ds
 - <https://wordpress.org/support/article/wordpress-features/>
 - <https://kinsta.com/knowledgebase/what-is-wordpress/>

- Blackboard:
 - [https://help.blackboard.com/Learn/Instructor/Courses/Manage Course Enrollment/Guest and Observer Access](https://help.blackboard.com/Learn/Instructor/Courses/Manage_Course_Enrollment/Guest_and_Observer_Access)
 - [https://help.blackboard.com/Learn/Administrator/Hosting/Security/Key Security Features/Access Control/Customizing the Gateway Page](https://help.blackboard.com/Learn/Administrator/Hosting/Security/Key_Security_Features/Access_Control/Customizing_the_Gateway_Page)
 - <https://www3.technologyevaluation.com/selection-tools/features-list/31881/blackboard-collaborate>
 - <https://www.essaytyping.com/blackboard-learning-system/>
 - <https://www.quora.com/Bb-What-are-the-advantages-and-disadvantages-of-blackboard-learning-system>
 - <https://www.trustradius.com/products/blackboard-learn/reviews?qs=pros-and-cons>
 - <https://blackboardlist.com/disadvantages-of-learning-system/>
 - <https://reviews.financesonline.com/p/blackboard-learn/its-advantages-and-disadvantages-55858/>
 - [https://help.blackboard.com/Collaborate/v12/Participant/Accessibility Features/System Requirements](https://help.blackboard.com/Collaborate/v12/Participant/Accessibility_Features/System_Requirements)
 - [https://help.blackboard.com/Learn/Instructor/Course Content/Course Files/Add Files to Course Files/Create HTML Objects](https://help.blackboard.com/Learn/Instructor/Course_Content/Course_Files/Add_Files_to_Course_Files/Create_HTML_Objects)
 - [https://help.blackboard.com/Privacy Statement](https://help.blackboard.com/Privacy_Statement)
 - <https://help.blackboard.com/Learn/Administrator/Hosting/Security/Privacy>
 - [https://help.blackboard.com/Learn/Administrator/SaaS/Integrations/Google Meet](https://help.blackboard.com/Learn/Administrator/SaaS/Integrations/Google_Meet)
 - <https://www.trustradius.com/compare-products/blackboard-collaborate-vs-google-hangouts>
 - <https://h5p.org/documentation/for-authors/h5p-for-blackboard>
 - [https://help.blackboard.com/Learn/Instructor/Getting Started/What Is Blackboard Learn](https://help.blackboard.com/Learn/Instructor/Getting_Started/What_Is_Blackboard_Learn)
 - [https://help.blackboard.com/Learn/Administrator/Hosting/User Management/User Accounts](https://help.blackboard.com/Learn/Administrator/Hosting/User_Management/User_Accounts)
 - [https://help.blackboard.com/Learn/Administrator/Hosting/User Management/Roles and Privileges](https://help.blackboard.com/Learn/Administrator/Hosting/User_Management/Roles_and_Privileges)
 - [https://help.blackboard.com/Community Engagement/Administrator/Community Settings/Account Management/Manage User Accounts](https://help.blackboard.com/Community_Engagement/Administrator/Community_Settings/Account_Management/Manage_User_Accounts)
- JOOMLA:
 - <https://extensions.joomla.org/>
 - <https://www.joomlms.com/buy-now.html>
 - <https://joom.techgasp.com/joomla-demos/chat-messaging/joomla-google-hangouts-master>
 - <https://extensions.joomla.org/category/multimedia/streaming-a-broadcasting/>
 - <https://h5p.org/node/865632>
 - <https://h5p.org/node/247389>
 - <https://brandongaille.com/12-pros-and-cons-of-joomla/>
 - <https://www.trustradius.com/products/joomla/reviews?qs=pros-and-cons>
 - <https://createdbycocoon.com/post/joomla-pros-cons>
 - [https://docs.joomla.org/Privacy Guidance for Joomla Extensions](https://docs.joomla.org/Privacy_Guidance_for_Joomla_Extensions)
 - [https://docs.joomla.org/J1.5:User Group Access levels explained in simple terms](https://docs.joomla.org/J1.5:User_Group_Access_levels_explained_in_simple_terms)
 - [https://docs.joomla.org/Adding a new user](https://docs.joomla.org/Adding_a_new_user)
 - [https://docs.joomla.org/Joomla Core Features](https://docs.joomla.org/Joomla_Core_Features)
 - <https://www.joomla.org/core-features.html>

- <https://www.joomla.org/announcements/67-about-joomla/overview.html>
 - <https://www.joomlms.com/>
 - <https://www.joomlms.com/buy-now.html>
 - <https://www.joomplace.com/elearning-extensions/joomla-quiz-deluxe.html>
 - [https://docs.joomla.org/J1.5:User Group Access levels explained in simple terms](https://docs.joomla.org/J1.5:User_Group_Access_levels_explained_in_simple_terms)
- Shakespeare, Tom. "The social model of disability." *The disability studies reader* 2 (2006): 197-204.