



InSIDE: Including Students with Impairments in Distance Education

**Delivery
DEV3.1**

**Assessment of the most widespread
LMSs**

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Abbreviations

Acronym	Term
AT	Assistive Technology
DE	Distance Education
HE	Higher education
HEI	Higher education institution
ICT	Information and communications technology
InSIDE	Including Students with Impairments in Distance Education
Iwl	Individual with impairments
JKU	Johannes Kepler University
LMD	Licence, Master, and Doctorate
LMS	Learning Management System
SaaS	Software as a Service
UABT	University of Aboubekr Belkaid Tlemcen
UAE	Abdelmalek Essaadi University
UB2LA	Blida 2 University
UCA	Cadi Ayyad University
UDL	Universal Design for Learning
UIT	Ibn Tofail University
UM5R	University of Mohammed V in Rabat
UMMTO	Mouloud Mammeri University of Tizi-Ouzou
UOA	National and Kapodistrian University of Athens
UOM	University of Macedonia
US	University of Sousse
USFAX	University of Sfax
USTO	University of Sciences and Technology of Oran Mohamed Boudiaf
UTM	University of Tunis El Manar
ViHeMo	Visual, hearing, motor
VLE	Virtual Learning Environment
WP	Work Package

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1. Introduction

This document provides a comparative analysis on the most widespread Learning Management Systems (LMSs) concentrating their accessibility and usability. The focus is on their use for providing Distance Education (DE) to learners with impairments. The aim of this document in the frame of the InSIDE project is the support of taking a decision about which LMS is going to be used as a foundation to provide accessible DE courses. This report is based on the results provided in the Delivery "PR1.3: Recording of LMSs" which presents a review of the current available alternatives of LMSs based on the study of the literature, previous researches and projects. A detailed list of LMSs with their advantages and drawbacks, their specifications and additional information by the manufacturer, as well as their potential use in the case of students with impairments, has been composed in the Delivery "PR1.3: Recording of LMSs" to serve as an updated guide in LMSs.

2. The most widely used LMSs

According to Delivery "PR1.3: Recording of LMSs" the most widely used LMSs all around the world are: Moodle, edX, aTutor, Chamilo, Totara Learn, Canvas and Edmodo. All seven alternatives have many features in common, however in pursuit of clarity and briefness the focus is on differences and most noticeable advantages and drawbacks.

2.1. Moodle

2.1.1. Moodle Overview

Moodle is a user-friendly LMS with an uncomplicated interface and easy drag-and-drop functionality. It also has extensive documentation and continuous usability enhancements that make it straightforward to learn and utilize.

The Moodle platform is constantly analysed and upgraded to address the changing preferences of its large user base, as an advantage of its highly agile, open-source system. It features a modular configuration that facilitates quick and cost-effective software development process.

Moreover, Moodle is available in over 100 languages, which makes it readily customizable per user locality or learning requirement. Again, as an open-source language, its large user community facilitates constant new language translations.

This LMS solution can be configured to any teaching modality. Moodle can be used exclusively for online courses or for blended pedagogy through simple setting-up of its features and by integrating other third party apps.

Furthermore, Moodle has a solid information security feature that is also regularly updated to ensure powerful protection to counter against illegal access and to prevent fraudulent use

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and loss of data. For further data security, you can readily deploy the platform on a private secure server or cloud.

As an online platform, Moodle is accessible anytime, anywhere. It is also compatible with any browser and any access device, ensuring that all its page elements and functionalities are complete and arranged as the original page design.

Moodle resources are readily available to both ordinary users for information purposes and advanced users for software development and higher-level system modification. Its large global user community, hundred-plus language translations, and numerous plug-ins/add-ons provide the comprehensive support that further enhance Moodle's user experience .

To sum up, Moodle excels in flexibility, community and possibilities in the way of deployment. It also has a large repository of plugins. All of these make it a good choice to use as a framework for a highly customizable implementation of a DE platform. However, from this high flexibility comes its biggest drawback: It causes the most costly maintenance, requiring specifically qualified IT professionals for developing, supporting and keeping updated.

2.1.2. Moodle Features

Moodle has the following features:

- Outcomes and rubrics
- Convenient file management
- Simple and intuitive text editor
- Notifications and automatic alerts
- Secure authentication and mass enrolment
- Multiple progress tracking options
- Customisable site design and layout
- Bulk course creation and easy backup
- Embed external resources
- Supports open standards
- Regular security updates
- Simple add-ons and plugin management
- Detailed reporting and logs
- Peer and self-assessment
- All-in-one calendar
- Multilingual capability
- Role & permission management
- Personalised dashboard
- Multimedia support
- Collaborative tools and activities.

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2.1.3. Moodle Accessibility

Moodle is designed to provide equal functionality and information to all people. This means that there should be no barriers for people regardless of disabilities, assistive technologies that are used, different screen sizes and different input devices (e.g.: mouse, keyboard and touchscreen) (moodle, 2019).

All non-text content in Moodle that is presented to the user has a text alternative that serves the equivalent purpose. The Moodle interface is presented as a HTML application developed to comply with the WCAG AA standard for accessibility. All parts of the Moodle interface are either native HTML controls with correct accessible text descriptions, or advanced HTML controls that have been developed to comply with the WCAG 2.0 AA as well as the Section 508 standards and tested with a range of screen reader software .

Furthermore, the “Atto text editor” that is default within Moodle provides many of the tools you need to design your course content with accessibility in mind. Some helpful functionality and features of the “Atto text editor” include the ability to edit section headings, provide descriptions for activities and discussion forums, and compose an answer to a quiz question. The “Atto text editor” also has an “Accessibility Checker” tool that will scan the content of the text editor and alert you to a range of accessibility issues that may be found within the text .

In addition, there are plugins available to download and install in Moodle that will provide additional accessibility features beyond what is provided by a standard install. One example is the Accessibility block which allows you to increase the font size of all text and apply high contrast color schemes .

2.2. edX

2.2.1. edX Overview

edX is a platform for education and learning. edX is more appropriate for Massive courses (MOOCs). Founded by Harvard and MIT, edX is home to more than 20 million learners, the majority of top-ranked universities in the world and industry-leading companies. As a global nonprofit, edX is transforming traditional education, removing the barriers of cost, location and access. Fulfilling the demand for people to learn on their own terms, edX is reimagining the possibilities of education, providing the highest-quality, stackable learning experiences including the ground-breaking “MicroMasters” programs. Supporting learners at every stage, whether entering the job market, changing fields, seeking a promotion or exploring new interests, edX delivers courses for curious minds on topics ranging from data and computer science to leadership and communications. edX is where you go to learn (edX, 2019).

edX is more focused on instructors, students and scaling by design. Due to the restricted customizability it results in a more rigid and inflexible solution. Furthermore, its development is not in the same way free as Moodle, mainly because large institutions involved in the project have a lot of influence in the development path and communities

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associated with it. Both of these reasons make edX a more easy and cheap solution to maintain. Drawbacks are shorter development history, restricted features and the smaller community compared to Moodle. Additionally, the necessity of having qualified IT professionals at hand, at least for the initial setup, is also a need for this alternative. Lastly, the course design tool is a very complete and complex feature that if in the future it did not meet the specific course requirements, that this project will surely have to face, then it would be a noticeable effort to modify. Therefore, this is seen as a risk.

2.2.2. edX Features

edX has the following features (OPENedX, 2019):

- Available for desktop, iOS and Android versions, the LMS provides access to course content and supporting infrastructure (schedules, discussion boards, collaboration tools, student administration, certificate generation, messaging, and more)
- Equally supports online courses, online campuses, and online degree programs
- Customizable learner experience reflects your unique brand identity and preferences.

2.2.3. edX Accessibility

Some of the most important accessibility features are the following (edX, 2019):

- Confirmation of edX's mobile applications and software platform with the "Web Content Accessibility Guidelines ("WCAG") 2.0 AA", published by the "World Wide Web Consortium".
- Development and distribution of "Accessibility Best Practices Guidance" for content providers.
- Appointment of a website accessibility coordinator who is knowledgeable on website accessibility and digital accessibility standards, responsible for coordinating edX's responsibilities with respect to accessibility, and responsible for developing the "Accessibility Best Practices Guidance".
- Modification of policies to prioritize accessibility bug fixes to ensure they are remedied with the same level of priority as any other equivalent loss of function for individuals without disabilities.

2.3. aTutor

2.3.1. aTutor Overview

aTutor is an open source web-based Learning Management System (LMS) used to develop and deliver online courses. Administrators can install or update aTutor in minutes, develop custom themes to give aTutor a new look, and easily extend its functionality with feature modules. Educators can quickly assemble, package, and redistribute web-based instructional content, easily import prepackaged content, and conduct their courses online. Students

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learn in an accessible, adaptive, social learning environment (ATutor – Learning Management System, 2019).

aTutor excels for the good implementation and support of accessibility. However, it is shadowed by the fact that the lead developer jumps out of the project and now the development community seems not to be very active. This issue could be seen as an indicator of project discontinuing. Other things to highlight in this option is the teaching resources. Reports and analytics are not so advanced and pack less functionalities than the other alternatives. In general also aTutor is associated with the risk for the project of ending up with major restrictions for further developments.

2.3.2. aTutor Features

aTutor has the following features:

- Built-in course authoring
- Learning management (LMS)
- Testing/assessments
- SCORM Compliant
- Unlimited student accounts
- Shared or private AContent repository
- SSL/HTTPS encryption
- Redundant system backups
- Community support
- eCommerce integration
- Custom modules
- DIV based themes
- Conforms with international accessibility standards
- IMS/ISO AccessForAll support
- Configuration
- Social networking
- Network profiles
- Create and join interest groups
- Contact database
- Photo sharing across courses or social networking area
- My Start Page dashboard
- Encrypted login passwords
- Course enrollment management
- Adaptive navigation
- Global, hierarchical, & sequential navigation tools
- Collaboration between learners (work groups)
- Forums
- Share resources using the file storage utility
- Project document authoring

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- Group blogs
- Private messages
- Feedback
- Preference settings
- Communication tools
- Search functionality
- Content package viewer (offline functionality)
- Content Tracker tool
- Test manager
- Score tracking
- Practice tests
- Glossary
- Links database
- Course search engine
- AContent repository search
- Instructor ATutor Handbook
- Guest access to courses
- File storage
- Content editor
- Visual editor
- API
- General statistics
- Backup manager
- Course categories
- Language manager
- Instructors can send bulk email
- Assignment drop box
- News & announcements.

2.3.3. aTutor Accessibility

aTutor includes a variety of features designed to ensure that content is accessible to all potential users, including those with slow Internet connections, older Web browsers, and people with disabilities using assistive technologies to access the Web. These features are described in detail below. Depending on the theme being used, aTutor may include all or some of the features listed here. The default theme includes them all (ATutor – Learning Management System, 2019).

- **Accessibility Verifier:** While using the “aTutor Content Editor”, instructors can check the accessibility of their content to be sure it can be accessed by all students, including those using assistive technologies, or older technologies. While using the “Content Editor”, select “Alt-A” to open the accessibility verifier.

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- **Accessible HTML Editor:** A “WYSIWYG HTML” editor that is both accessible and usable by content authors using assistive technologies, and helps authors create accessible content.
- **Alternative Text:** All meaningful images in aTutor include a text alternative that describes the image or its function. Where images are not meaningful the “Alt” attribute is left empty so assistive technologies will ignore the image.
- **Alternative Navigation:** Global, hierarchical, and sequential navigation tools are available so users can view or structure content in a manner that suits their style of learning. The “aTutor SiteMap” provides a full list of all content and tools available, so all features in a course can be accessed from a single location.
- **Resume/Continue:** aTutor remembers the last page accessed when users leave the course content, to go to the Forums for instance, so they can quickly find their way back to where they left off. The content location is also remembered between sessions, so when returning to aTutor, users can simply choose the Resume link in the course listing on “My Courses”, or select the resume link in the breadcrumbs at the top of the screen once in a course. Using the “Alt-.” accesskey will also return a user to the last content page they were viewing after they have entered into a course.
- **Hide Menus:** For users of older assistive technologies that do not support columnar text laid out in tables, it is possible to hide aTutor's content navigation menu so that content will be displayed in a linear presentation. Hiding the content menu also conserves space for users viewing aTutor on smaller screens.
- **Search and Sort:** Most data tables are accompanied by a search tool, or filter, so specific records can be displayed in the table, reducing the amount of data displayed at any given time. Most data tables can also be sorted by selecting the column header label, again allowing users to narrow down the data display.
- **Table Header Associations:** All data tables are marked up with the <th> element and the scope attribute to ensure that screen reader users are able to navigate through data displays and understand what each data cell represents.
- **Form Labels:** All form fields throughout aTutor are marked up using the “label” element to ensure that they are properly described for assistive technology users. Explicit labeling in this manner also makes it possible to click on a form field's label to activate the field. This provides a larger target area for those people who have difficulty positioning a mouse pointer on a small form field such as a radio button or a checkbox.
- **Style Sheets:** Wherever possible, the presentation of content in ATutor is controlled by style sheet elements. This allows users to override aTutor's default appearance and apply their own preferred presentation styles (e.g.: increased font sizes, different font styles, colours, etc.)
- **Form Field Focus:** For pages where the primary content is a form, the cursor will automatically be placed in the first field so that after a form page loads, users can begin typing into the form. Users may choose to disable form focus in their preference settings if it interferes with their use of form screens.

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- **Relative Sizing of Images:** With browsers that support resizing of images, aTutor icons can be magnified for users with low vision, making them more easily visible. Wherever possible relative measures have also been used for other feature within aTutor so when the interface is magnified or reduced, all features resize relative to each other, maintaining the screen's symmetry.

2.4. Chamilo

2.4.1. Chamilo Overview

Chamilo is a free open-source solution that allows you to develop your own improvements and extensions, and you can also share them with the user community. It allows teachers to control their classes and place the content conveniently in the student's learning environment to facilitate enjoyable learning. This product is easier to use and teach compared to most other online learning solutions. Moreover, teachers and students can effortlessly access course content. This reduces the abandonment rate for distance learners. Additionally, companies can improve their chances of attaining their corporate training goals. Another highlight is Chamilo's online editing tool that empowers instructors to develop new content at lower cost. This tool enables them to quickly create a self-assessment, add tests, and import outside content. Chamilo is an e-learning and content management system that empowers you to improve access to knowledge and education globally. This LMS is backed by the Chamilo Association which strives to promote the software, maintain clear communication channels, and develop a network of software contributors and services providers. Finally, Chamilo's backers aim to constantly improve this collaboration and e-learning software and increase the community of enterprise learning trainers and teachers who utilize this tool to improve their courses and teaching capabilities .

2.4.2. Chamilo Features

Chamilo has the following features :

- Free, open-source solution
- Multi-lingual
- Collaborative and interactive learning environment
- Easy access to course content
- Online editing tool
- Can be integrated with existing IT infrastructure
- Gamification options
- Mobile videoconferencing.

2.4.3. Chamilo Accessibility

Chamilo include several features that can be useful when designing accessible experiences, like the "fonts resizing" which you can enable through the admin panel. Enabling this option

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will display a series of alternatives to modify font sizes, allowing people with vision issues to read course contents more easily.

There is also a possibility to display larger icons, which not only eases visualization, but also makes it easier for people with mobility disabilities to "touch" the icons more easily (Chamilo – E-Learning & Collaboration Software, 2018).

2.5. Totara

2.5.1. Totara Overview

Totara melds learning management with performance management to provide course authoring, learning progress tracking, certification path management with performance appraisals, goal and feedback management. Furthermore, this LMS has the capacity to author and manage self-paced, instructor-led, learning, social learning, or even face-to-face learning programs. You can likewise define and manage certification programs to assure compliance. Individual learning plans can be created to plan and track learning for employees based on their objectives, competencies, and on compliance needs in Totara Learn. Finally, Totara Learn includes motivational badges recognize and gamify employee learning achievements.

Totara has the following benefits, as far as the learning process is concerned (webanywhere, 2019):

- **The flexibility of open source:** With Totara, there's no ongoing cost of licence fees or reliance on a third party to make changes in the future. You also have the ability to customise and change the features of your LMS to your brand specifications.
- **Advanced reporting and analytics:** Totara with "Webanywhere" allows you to manage performance with flexible appraisals, learning plans, self-service course booking and advanced reporting.
- **Available anytime, anywhere:** Totara can be accessed by all users, wherever they might be via their web browser. No software installations required. This is just one of the reasons why Totara is easy and simple to use.
- **Compliance learning, made simple:** Easily keep track of course completions for obligatory modules such as health and safety, inductions and governance.

Here, we should mention some of Totara's most important key features (webanywhere, 2019):

- **Easy-to-use, responsive interface:** means anyone can access the full power of Totara on all devices, while the visual theming can be fully re-branded without compromise.
- **Unified learning and performance** allows you to capture and assess learning, manage professional development, and optimize people performance across your organization.
- **Learning Plans** for every learner, based on job roles and associated competencies, provides quick and targeted access to relevant learning and tracking.

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- **Competency frameworks** enable curriculum planning, learner pathways, and developmental needs analysis. Link skills to employees or extended enterprise learners based on position and organization with competency tracking.
- **Adaptive learning** allows you to create custom learning pathways for different user groups to improve learning performance.
- **Organization and position hierarchies** allow you to track specific competencies, assign learning, and automatically filter reports.
- **Instructor-Led Training (ILT)** with seminar-based training management, self-service and manager approval booking, and attendance tracking.
- **Flexible reporting** with personalized dashboards, custom and graphical reporting, completion tracking, and scheduling and exporting of results helps you ensure compliance. Assign reports to team or divisional managers.
- **Sophisticated assessment engine** allows you to create assessments from question banks and track scores and completion rates.
- **Administrative user interface** enables you to integrate with HR, CRM, and other systems to keep all compliance data in one place, simplify the user experience, and optimize workflows.

2.5.2. Totara Features

Totara has the following features (synergy learning, 2017):

- Totara LMS is used globally by more than 800 organisations and 7 million end users
- It is an open source platform giving you the flexibility to work with it, customizing the LMS to your specific requirements
- Development can be sustained by simple, affordable subscriptions
- The platform is built around a responsive framework, making it easily accessible from any location on mobile, desktop and tablet devices, saving organisations time and resources on learning administration
- Totara LMS can be easily integrated with existing internal systems
- Totara LMS is available via a web browser allowing for quick implementation and making it easy for your users to access
- The robust reporting capability allow you to build custom reports tailored to your requirements
- There are no licence fees making it an affordable and valuable LMS choice for your organisation
- Totara LMS meets compliance requirements by allowing learners to monitor progress and access activities directly
- Totara LMS is used by many of the world's biggest and most trusted organisations.

2.5.3. Totara Accessibility

Totara has the following accessibility features (totara.help, 2019):

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- Users can navigate and control Totara with only a keyboard. Browser focus can be changed using the tab key. These capabilities are predominantly supplied by the browser with some aid from JavaScript.
- Totara’s functionality is delivered through standard web browser technology.
- For sighted users, a blue outline is added to controls that have focus. Assistive technologies handle focus events correctly.
- Alt text is used in core functionality and is encouraged in user generated content.
- Icons and images are used consistently throughout Totara.
- Totara does not use color alone to convey information, indicate actions, prompt for responses, and/or distinguish visual content.
- In places where Totara provides settings to adjust color, a large color selection is provided. Theme developers can fully customise the platform's appearance using all colors and contrast levels supported by modern browsers.
- No portion of Totara uses flashing or blinking text, objects, or other elements.
- Most locations in Totara provide appropriate label, fieldset and ARIA attributes. Any forms that do not provide appropriate attributes can be remediated by code changes.
- Totara provides a description in the “ALT” tag of all meaningful images. It does not provide text descriptions of decorative elements (which are non-relevant). Totara Learn displays alternative text content when content embedded by “object” tags is disabled or unsupported.
- Totara uses semantic HTML in all known locations wherever HTML is presented. In the event that locations are discovered where non semantic HTML is still used, access to the application's source code is available and can be modified by developers during installation and configuration.
- Totara distinguishes row and column headers. In the event that locations are discovered where table rows and column headers are not identified, access to the application's source code is available and can be modified by developers during installation and configuration.
- Totara uses markup to associate data cells and header cells for data tables that have two or more logical levels of row or column headers. There's only one known place with two or more logical levels of row or column headers (the gradebook editor).
- Totara uses text to title frames and facilitate frame identification and navigation. There are only two known places that use frames: the SCORM activity and the site policy feature.
- Totara Learn provides a print layout view in some activity modules, and other methods in other cases.
- Totara Learn provides skip links in a number of locations (allowing users to skip content).

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2.6. Canvas

2.6.1. Canvas Overview

Canvas is committed to the refinement of the educational experiences shared by its users on its platform. It has been partnering with leading innovations to help teachers and students succeed. It currently leads in LTI integrations among LMS vendors, but the company is still making more moves to improve its services overall. Canvas is perfect for blended learning programs. Learning institutions enjoy Canvas' comprehensive features and how they are contained in just a single platform. Canvas LMS has helped set up an "1:1" initiative with Chromebooks and iPads for more than fifty thousand users and integrate its comprehensive educational tools plus their existing student information system. Thanks to its open architecture the possibilities of its integrations are limitless. These types of programs are what Canvas continues to support and create. With Canvas, you can provide a consistent learning experience, especially for K-20 learners. It is generally acceptable that learning is done differently today and, at many times, in different settings and devices. Students also learn via projects and internships. A bubble-sheet is not enough to assess these types of learning. With Canvas, learning can be showcased via Portfolium, an e-portfolio where students' education can be mapped out and curated. Achievements can be compiled including non-traditional evidence of learning that is shareable to future schools, colleges, and even prospective employers. Used right, this can give teachers a conducive path to lead and assess their students' development. Also, this gives students more opportunities for advancement that they clearly deserve. One more Canvas' characteristic is that has a cloud-based architecture that supports reliable connectivity and real-time data updates. In this way, educators can gather formative data to guide individual instruction. With MasteryConnect, this data can be analysed and gathered with top-of-the-line assessment tools. Also, connectivity is further enhanced by Canvas Catalog where you can publish courses to reach more learners. Together with the Blueprints feature, institutions such as districts, schools, and universities can lock aspects of their curriculums or published courses. This enables you to standardize practice and guarantee high-quality education connecting generations. This connectivity is also very reliable. Canvas offers a 99.9% uptime as per SLA. As it is hosted by Amazon Web Services (AWS), this cloud-based LMS functions with great speed and precision.

2.6.2. Canvas Features

Edmodo has the following features :

- Customizable user profiles
- Open API
- Audio and video messages
- Web-standard browser
- Cut and paste links from a Web browser
- LTI integrations

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- Integrated tools like Google Docs and Etherpad
- Supports external service integrations, like Facebook, Google
- Collaborative workspaces
- Canvas app center
- Robust course notifications
- Graphic analytics reporting engine
- Canvas mobile apps for iOS and Android
- Integrated media reporting
- Students can record or upload audio and video
- Integrated learning outcomes
- Canvas' content editor to share resources
- RSS support
- Web conferencing tools
- Analytics.

2.6.3. Canvas Accessibility

Ensuring an accessible and pleasant experience to all users, regardless of disability, is a key focus of Canvas. The Canvas platform was built using the most modern HTML and CSS technologies, and is committed to "W3C's Web Accessibility Initiative" and "Section 508" guidelines (CANVAS, 2019).

Some of the most important Canvas' accessibility features are the following (CANVAS, 2019):

- **Canvas navigation with a Screen Reader:** Canvas makes extensive use of "ARIA landmark" regions. "Accessible Rich Internet Applications (ARIA)" defines ways to make web content and web applications more accessible to people with disabilities. Therefore, the best way to get around in Canvas is to navigate via regions. Within regions, Canvas uses HTML headings, so navigating between headings can be helpful.
- **Moving content within Canvas:** Wherever drag and drop is used to reorder components, the "Move-to" option is also available and allows both screen readers and keyboard users to move Canvas content. The "Move-to" option is available in the following features:
 - Course navigation
 - Modules
 - Discussions
 - Assignments
 - Outcomes
 - Quizzes
- **Keyboard shortcuts:** By pressing the comma key, users can view a pop-up window with shortcuts for keyboard navigation.
- **Accessibility within specific Canvas' features:** Several areas within Canvas have been specifically improved for accessibility. Other features may be limited at this time. This section highlights several feature areas and accessibility behaviors:

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- **Font sizing:** The Canvas interface uses rem sizing for fonts so any typography will meet the following: it will zoom when the browser is zoomed, and it will scale if a custom browser sized font is chosen or set from a browser's setting.
- **Rich Content Editor:** The “Rich Content Editor” supports multiple accessibility features for easy creation of accessible content.
- **Calendar:** The Calendar supports “Agenda View”, which lists all assignments and events in a list or agenda format.
- **Quizzes:** Quizzes allows instructors to moderate a quiz for individuals requiring more time or who need multiple attempts.
- **Gradebook:** Both the default (assignment) Gradebook and the “Learning Mastery Gradebook” support an individual view, where instructors can view assignments and grades for one student at a time.
- **User settings:** The “User settings” page hosts two feature options to enhance accessibility.
- **High contrast UI:** When enabled, this feature offers higher contrast in buttons, tabs, and other areas throughout Canvas.
- **Underline links:** When enabled, this feature underlines hyperlinks in navigation menus, the Dashboard, and page sidebars.
- **Chat tool:** The “Chat tool” has an option to enable audio notifications when new messages are posted.
- **SpeedGrader/DocViewer/Annotations:** Students can now access annotations and comments with a screen reader, including information about the annotation type, author name, comment, and any reply comments at the end of the document.

2.7. Edmodo

2.7.1. Edmodo Overview

Edmodo can build your collaborative network. Moreover, it has the ability to connect all teachers, parents, students, and administrators in your school or district through a secure Edmodo web address. Edmodo supports collaboration in schools, classrooms, and across your district to improve professional learning networks, supported by a global community of educators. Furthermore, it easily deploys and manages digital assets, and track usage patterns and student progress on your school or district dashboard. The only way to find out if you are effectively getting through to your students is by measuring their progress. With Edmodo, you have access to a unified database that lets you check the grades and the participation level of your students. In addition to that, this has a feature that lets you monitor the reactions of students to certain activities and classroom discussions. This way, you can easily pinpoint which aspects of your lesson your students are having a hard time with. While Edmodo already has a complete suite of online learning tools, it still offers a highly customizable and extendable interface. This allows users to integrate applications and widgets into their lesson plans in order to provide an even more engaging learning

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experience for students. Finally, on Edmodo, teachers are at the center of a powerful network that connects them to students, parents, administrators, and publishers. This network offers top rate resources and tools, providing the building blocks of a high quality education.

2.7.2. Edmodo Features

Edmodo has the following features:

- Online classroom discussions
- Create polls for students
- Award badges to individual students
- Network that connects students, administrators, parents.
- Measure student progress
- Personalize with apps
- Activate your free admin account
- Build a network of communities
- Accelerate learning goals.

2.7.3. Edmodo Accessibility

Edmodo is accessible to all users. Students/teachers/parents/administrators are able to access the tool using various devices, with all browser types, and from anywhere, anytime and anyplace (Alleyne Bayne, 2013).

3. Comparison of current LMSs

Based on the characteristics that have been mentioned in the previous section, Table 1 presents a comparison of the main features between the LMSs: Moodle, edX, Chamilo and Canvas.

LMS Features	Moodle	edX	Chamilo	Canvas
Academic/Educational	✓	✓	✓	✓
Asynchronous Learning	✓	x	✓	✓
Blended Learning	✓	x	✓	✓
Built-in Course Authoring	✓	✓	✓	✓
Corporate/Business	✓	x	✓	✓
eCommerce	x	x	x	x

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eLearning Companies	✓	x	x	✓
Gamification	✓	x	x	✓
Learn Portal	✓	x	x	✓
Mobile Learning	✓	x	✓	✓
SCORM Compliance	✓	x	✓	✓
Synchronous Learning	✓	x	✓	✓
Video Conferencing	✓	x	✓	✓

Table 1. Comparison of the main features between Moodle, edX, Chamilo and Canvas.

Based on the characteristics that have been mentioned in the Section 2, Table 2 presents a comparison of the main features between the LMSs: Moodle, aTutor, Totara Learn and Edmodo.

LMS Features	Moodle	aTutor	Totara Learn	Edmodo
Activity Dashboard	✓	✓	x	x
Assessment Management	✓	✓	x	✓
Assignment Management	✓	✓	x	x
Backup Management	x	✓	x	✓
Blended Learning	✓	✓	x	✓
Bulk Send	x	✓	x	✓
Calendar Management	✓	x	x	✓
Chat	✓	✓	x	✓
Collaboration Tools	✓	✓	x	✓
Collaboration Workspace	✓	x	x	✓
Configuration Management	x	✓	x	✓
Content Repository	x	✓	x	✓
Course Authoring	✓	x	x	✓
Customizable Branding	✓	✓	x	x

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Customizable Categories	x	✓	x	✓
Feedback Collection	x	✓	x	✓
File Management	x	✓	x	✓
Instant Messaging	✓	✓	x	x
Multi-Language	✓	✓	x	✓
Online Forums	x	✓	x	✓
Search Functionality	✓	✓	x	x
Self-Learning	x	✓	x	✓

Table 2. Comparison of the main features between Moodle, aTutor, Totara Learn and Edmodo.

Based on the characteristics that have been mentioned in the Section 2, Table 3 presents a comparison of the main features between the LMSs: Moodle, Canvas, aTutor and Edmodo.

LMS Features	Moodle	Canvas	aTutor	Edmodo
Activity Dashboard	✓	x	✓	x
Assessment Management	✓	x	✓	x
Assignment Management	✓	x	✓	x
Blended Learning	✓	x	✓	x
Chat	✓	x	✓	x
Collaboration Tools	✓	x	✓	x
Customizable Branding	✓	x	✓	x
Instant Messaging	✓	x	✓	x
Learning Management	x	✓	✓	x

Multi-Language	✓	x	✓	x
Search Functionality	✓	x	✓	x

Table 3. Comparison of the main features between Moodle, Canvas, aTutor and Edmodo.

Table 4 presents a comparison of the main characteristics between the seven selected LMSs.

LMS Features	Moodle	edX	aTutor	Chamilo	Totara Learn	Canvas	Edmodo
Usability	+	++	+	++	+	++	+
Authoring tool	++	+	o	+	++	+	++
Interoperability	+	++	o	++	+	+	+
File repository	++	+	o	++	o	+	++
Video	++	++	+	++	++	++	++
Audio	++	+	+	+	+	+	+
Forum	+	+	+	+	o	o	+
Chat	+	+	+	+	+	+	++
Task and mark	+	++	+	++	++	+	+
Reports	++	+	o	+	++	+	+
Analytics	++	++	-	+	++	+	+
Student mgmt.	++	++	+	++	++	+	++
Public	+	+	+	+	+	+	+
Private	+	+	+	+	+	+	+
Internationalization	++	+	+	++	+	+	+
Accessibility compliance	++	+	++	o	+	++	+
Keyboard-only	+	+	++	o	o	++	++
Screen reader	++	+	++	o	o	++	++
Subtitles	+	+	+	o	o	++	o
Maintenance	o	++	+	++	o	++	+
Documentation	++	+	o	++	++	++	+
Community	++	+	-	++	+	+	++
Server based	+	+	+	+	+	o	o
SaaS	Third-party	+	Third-party	+	+	+	+
License	GPL	AGPL	GPL	GNU/ GPLv3	GNU FDL/ GPLv3	GNU/ GPL	GNU/ GPL

Table 3 Summary of learning management systems and features

-: Does not exists

o: Inadequate in terms of a particular feature

+: Slightly adequate in terms of a particular feature

++: Adequate enough in terms of a particular feature.

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4. Discarded LMS from comparison

For completeness, this section gives a brief overview to discarded LMSs although they are in use at some partners' learning/teaching environments. It could worth mentioning and noting most relevant features in order to be aware of their existence when updates are made and according features are searched/adapted in the system in use in the project.

4.1. Google Classroom

Website: <https://edu.google.com/products/classroom>

Community: <https://support.google.com/edu/classroom/community>

Accessibility: <https://edu.google.com/why-google/accessibility>

Google Classroom is a cloud based classroom management system developed by Google Inc. It was initially released in 2014 and since then its use has increased worldwide year by year.

The advantages of this software are the lack of deployment/setup in a dedicated server, ease of use for instructors and students and universal accessibility. All of them make it one of more direct and easiest paths for classroom digitalization.

On the other hand, the whole project relies on other Google solutions like Docs, Drive and Gmail so the integration with Google ecosystem is granted. However, it can be seen as a disadvantage because the use of this software leads to a strong dependency on one company that controls not only the software but also all tools that students may use for learning. Hosting content on external servers might cause problems to teaching organizations.

4.2. WizIQ

Website: <https://www.wiziq.com>

Community: -

Accessibility: -

WizIQ is a cloud based online virtual classroom and a LMS developed by a private company with the same name. It was initially released in 2007 and it is used by the company to deliver DE services like live classes, webinars, self-paced courses and employee and customer trainings.

As software as a service (SaaS), it removes the complexities of maintenance and deployment what allows to focus on the teaching tasks. Additionally, as it focusses mainly on virtual classrooms for live and interactive online classes, it excels in tools like discussion boards, video streaming, assignments, feedback and analytics in an easy to use way.

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The main disadvantage is the missing free use option. Accessibility is not promoted like in other similar solutions and it allows little customization which restrict the design of courses. Finally, it is worth to mention that it does not support many languages.

5. Conclusion

Based on both approaches of evaluation, the comparative desktop study and after asking partners about DE in their institutions, the comparison let us conclude that Moodle is the most recommendable system to be used in the InSide project. It supports accessibility, is very flexible and we can expect the needed support at most partner institutions (or such support is much easier to find than for other candidates). It meets all requirements in terms of accessibility, functionality, usability, customization and license. Moreover, partners show a noticeable expertise in providing DE with this software, which indicates that the future use and development could be less costly than with other alternatives.

Moodle enables teachers to provide graded assignments, lessons, and choice, to share documents, quizzes, workshops, and chat, and to offer a forum for learners, in a manner that is both easy and offers high quality learning. Moodle is one of the most userfriendly and flexible of the globally-free open source courseware products available, and is specifically designed to help educators who want to create high quality on-line courses (moodle, 2019; Wharekura-tini & Aotearoa, 2004; Cole & Foster, 2007). It has excellent documentation, strong support for security and administration, and is evolving towards Information Management System/Shareable Content Object Reference Model (IMS/SCORM) standards (Berry, 2005; Zenha-Rela & Carvalho, 2006; Brandl, 2005).

Moodle, as an e-learning system, has been developed by a long list of specialists who have contributed to the development of its many stages. It contains all development information as well as a roadmap, a coding guide, and a commonly-used way of managing source codes for large software projects when accessing source codes. Moodle is available in a variety of download packages with different levels of constancy from <http://download.moodle.org> (moodle, 2019; Williams & Dougiamas, 2005). Moodle as a VLE (Virtual Learning Environment) has an important feature which is the Moodle.org web site, which provides a central point for information and collaboration among Moodle users, who include system administrators, instructional designers and of course, developers. This site is always evolving to suit the needs of the community. Moodle is now used not only in universities, but also in high and primary schools, non-profit organizations and private companies, by independent teachers and even homeschooling parents. A growing number of people from around the world are contributing to Moodle in different ways (Tortora et al., 2002; moodle, 2019; Dougiamas, 2004).

Moodle is based on Social Constructionist Pedagogy, which is a learner-oriented philosophy and most VLE modules are based on it. They are largely concerned with how course contents are delivered to students who are involved in constructing their own learning package (Cole & Foster, 2007; Sabine & Beate, 2005). The learner-oriented philosophy to learning is where learners actively construct new knowledge through personalized modification by adopting a more subjective stance to the knowledge being created, and they learn even more by explaining what they have learnt to others. These ideas run parallel to the way open-source

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development works, in which the developers are also often users, where everyone is free to tinker with the software, and where codes are constructed, peer-reviewed and refined by means of open discussion (Berry, 2005; Chavan & Pavri, 2004).

5.1. The Reasons for Choosing Moodle

The importance of Moodle is that it rates well according to many reports, has a high grade of acceptance in the community and in a number of institutions, and has a wide variety of active courses, available in many languages (Cole & Foster, 2007; Williams & Dougiamas, 2005). It gives users the ability to post news items, assignments, electronic journals and resources, and to collect assignments etc. The greatest strength of Moodle is that the community has grown around the project; both developers and users participate in Moodle's active discussion forums, sharing tips, posting code snippets, helping new users, sharing resources and debating new ideas (Zenha-Rela & Carvalho, 2006; Chavan & Pavri, 2004; Itmazi, 2005).

Therefore, we have chosen the software of Moodle to be our field of research and analysis. It is important to understand the Moodle environment, and to explore its functionalities and limitations in order to develop practical examples for the use of VLE in Qassim University. We list here the most important reasons for choosing Moodle:

1. It is an OSS, which means users are free to download it, use it, modify it and even distribute it under the terms of the GNU license (Tortora et al., 2002; moodle, 2019; Zenha-Rela & Carvalho, 2006; Chavan & Pavri, 2004; Shearer, 2003).
2. It is a CMS & VLE that lets teachers provide and share documents, graded assignments, discussion forums, etc. with their students in an easy-to-learn fashion, and in high quality on-line courses (moodle, 2019; Berry, 2005).
3. Moodle can be used on almost all servers that can use PHP. Users can download and use it on any computer and can easily upgrade it from one version to the next (Dougiamas, 2004; Chavan & Pavri, 2004; Itmazi, 2005).
4. The key to Moodle is that is developed with both pedagogy and technology in mind. One of the main advantages of Moodle over other systems is its strong grounding in social constructionist pedagogy and good educational tools (Cheng-chao, 2005).
5. The Moodle software is used all over the world by independent teachers, schools, universities and companies. The credibility of Moodle is very high. Currently, there are 3324 web sites from 175 countries that have registered with it, and it has 75 languages (moodle, 2019; Berry, 2005; Chavan & Pavri, 2004).
6. Moodle runs without modification on any system that supports PHP such as Unix, Linux and Windows. It uses MySQL, PostgreSQL and Oracle databases, and others are also supported (Shearer, 2003).
7. It has many features useful to potential students such as easy installation, customization of options and settings, good support/help, and good educational tools. Moreover, it has excellent documentation, and strong support for security and administration (Cheng-chao, 2005).

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5.2. The Limitations of Moodle

Moodle's low cost, flexibility and ease of use helps bring VLE technology within the reach of those with limited technical or financial resources (Williams & Dougiamas, 2005). On the other hand, Moodle has some limitations as follows:

1. Moodle seems to be complex for a number of users such as teachers and administrators (Chavan & Pavri, 2004).
2. It is difficult for beginner technicians to install and use Moodle, because there are many technical word lists in installation instructions (Williams & Dougiamas, 2005).
3. Lack of simple-to-obtain support. Forums carry a great deal of information, but nearly all forums are in the English language (Chavan & Pavri, 2004).

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