EUNIS 2016: Creating Virtual Learning Environment for Higher Education Institutions

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INTRODUCTION

University of Zagreb, University Computing Centre (SRCE) has a central role in the systematic implementation of e-learning not only at the University of Zagreb but also at other higher education institutions in the Republic of Croatia.

Providing a stable and rich Virtual Learning Environment (VLE) for a large number of teachers and students is an extensive and challenging task. The process of setting up and maintaining a VLE consists out of three important components: software, infrastructure and user support. Each of these components is essential for a smooth running system and providing good user experience.

In this paper we will present our experience in building and maintaining a VLE at the University of Zagreb, University Computing Centre SRCE since 2007.

THE E-LEARNING CENTRE AT SRCE

The E-learning Centre (ELC) was established at the University of Zagreb, University Computing Centre in 2007 and today is a focal point for systematic take-up and supporting e-learning across the higher education institutions in Croatia. Some of the activities that the Centre engages in are supporting teachers and students in use of e-learning technologies, cooperating with and supporting local e-learning teams and groups, ensuring a generally accessible e-learning platform (LMS/VLE), maintaining a network (of professionals, teachers and students) for sharing knowledge and experience in e-learning but also promoting the use of new technologies in education. Creating a positive environment and raising awareness of e-learning within the academic community is one of the priorities as well.

Within the Centre, we try to provide a multidisciplinary support and recognize specific needs of our users. For that reason the team consists of people with a wide variety of skills such as software development, instructional design, pedagogy, graphical design etc.

VLE MERLIN - SOFTWARE

Throughout the years, Moodle has established itself as the leading open source Learning Management System in education. It is widely used in higher education around the world and provides a reliable system that brings new features and improvements with every new version. Also, since Moodle is open source software with large community, number of great extension plugins and good online user and developers documentation. These were some of the main reasons why Centre chose Moodle for the LMS as well. The first installation was made in 2007 and has been continuously upgraded and developed since then. The present installation translated is in Croatian language, with number of adjustments and improvements made by the Centre team based on the needs and requirements of the teachers. The e-learning platform, together with e-portfolio system, system for webinars and connection with Information system of Higher Education Institutions (ISVU) builds the VLE for Higher Education Institutions.

Providing a sustainable and easily accessible VLE for over 40 higher education institutions (universities, faculties, polytechnics and professional schools) requires a system that will satisfy very diverse needs. Currently, the VLE Merlin hosts over 4,700 e-courses, used by over 2,100 teachers and 28,000 students in the current academic year, with over 12,200 archived e-courses and over 75,200 users in total.

Moodle version 2.9 has been installed for the academic year 2015/2016 and it provides users with modern and contemporary LMS. Installation of additional modules, development of new ones as well as modification of existing code enables fitting Moodle to the specific user needs. Integration of Moodle with Mahara (e-portfolio system) extends the e-learning environment with a tool for student-centred learning. The e-portfolio system can be used as a single tool or in conjunction with Moodle enabling an export of data or grading students' e-portfolios as an assignment. Real-time communication with rich presentation and meeting control features is provided through webinar system based on Adobe Connect. Version 9.4, which is presently hosted, enables customization and integration with Moodle. Integrated and extended systems can enable a different kind of e-learning and comply with the specific teacher/student needs. VLE can be used for blended learning courses or organization of the fully online studies.

The VLE at SRCE is titled Merlin (http://merlin.srce.hr) and is connected with other information systems like ISVU and MojOblak (remote storage system based on ownCloud) further extending system usability. All systems are accessible using Single Sign-On (SSO) for authentication and authorization through AAI@EduHr infrastructure. AAI@EduHr is the Authentication and Authorization Infrastructure of science and higher education in Croatia. Technically, AAI@EduHr is a hub-and-spoke federation with centralized login service. Each Identity provider (institution) maintains its own LDAP directory and related IdM software. For SSO implementation at AAI@EduHr Security Assertion Markup Language (SAML) 2.0 is used.

Since study programmes in Croatia usually last for five years, Merlin is organized in such a way to enable students to access their courses throughout their entire study. For each academic year, a separate Moodle installation is used. Teaching and classes are organized within the Merlin system for the current academic year, while previous courses are archived and still accessible for teachers and students.

Integration with ISVU is very important as it provides significant benefits in organization of e-courses but also in management of teachers and students. It is possible to open courses on Merlin directly from ISVU as well as enrol and synchronize students and teachers and divide students into groups. Moodle by itself provides great features with integration with many remote storage systems like Google Drive, Dropbox etc. but to use these systems, users need to create new accounts. Also, storing learning materials or sensitive research data on remote systems always involve security issues. Having that in mind, SRCE established the service titled MojOblak which provides a large storage space (100GB for employees and 20GB for students) to all academic members (researchers, teachers and students). MojOblak is available within Moodle as any other repository and is accessed using SSO.

With the increased use of mobile devices and importance of timely notifications from the systems, Moodle Mobile capabilities are used. Customized application called Merlin Mobile is available for users with Android mobile devices enabling receiving of nearly instant push notifications. Using Merlin Mobile application it is possible to access online courses using a smartphone, participate in many activates and send or receive messages and notifications.
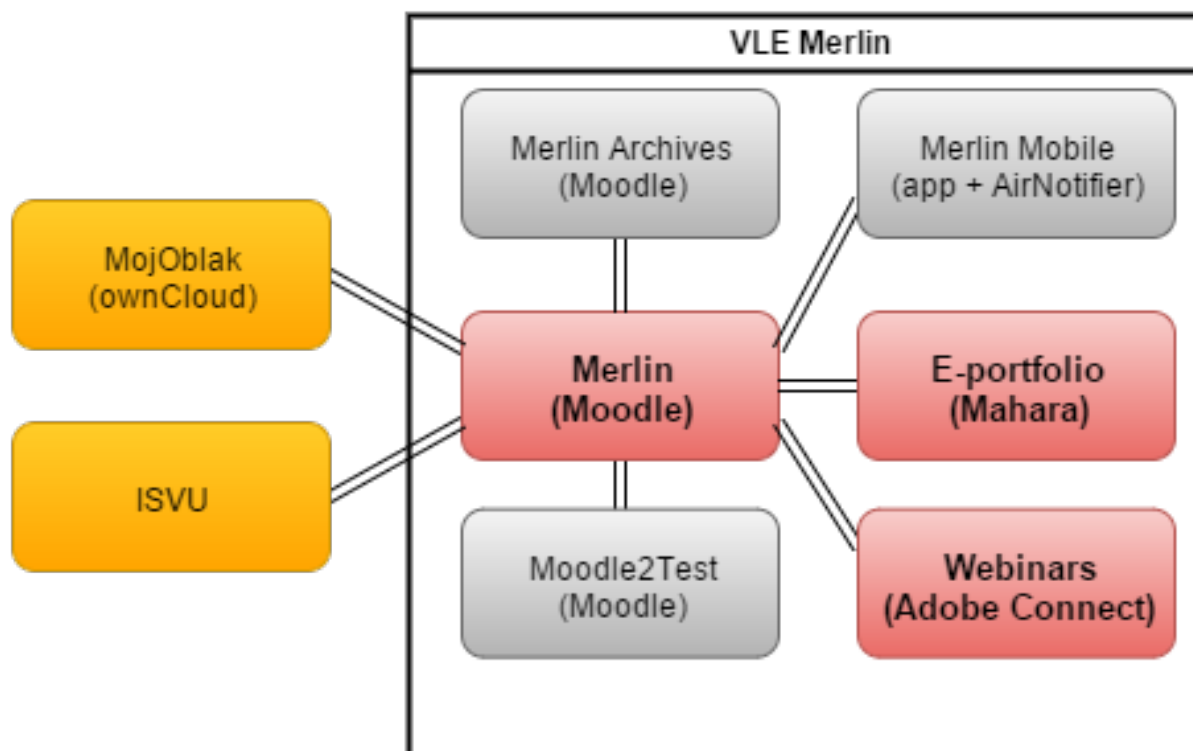
VLE MERLIN - INFRASTRUCTURE

To ensure efficient work of the system, it must be set up on good foundations. Computer infrastructure should have high performance to support a large amount of users at any task they might be performing. For VLEs such as Merlin, which is used in higher education in Croatia, it is crucial that the system is available to users 365/24/7. It is important to ensure availability and accessibility of the system at any time and from anywhere. Students should be able to access their learning materials or participate in the scheduled activities whenever they need without any restrictions. Teachers should be able to access their e-courses in order to prepare new learning materials, set new tasks for students, to evaluate their work and to communicate with students at the time they prefer. An important issue is also reliability of data as every piece of data (like exam results) needs to be stored and available at any time. Scheduled backups are essential for data recovery purposes. For this purpose, each server is backed up on daily basis as well as the user data and databases. As mentioned previously, online courses on Merlin are available for five academic years. The older courses are backed up on tapes and can be easily restored if needed.

All servers at the SRCE run on hypervisor. Virtualization systems provide hardware fault tolerance as servers can be migrated to a different host as needed but also provide high performance as computer resources are allotted where and when needed. Multiple servers organized in clusters and accessed through load balancer provide high performance through distribution of load evenly on all servers in the cluster, but also high availability, as the system will continue to work as long as there is still at least one active node in the cluster.

VLE Merlin is organized on two separate clusters as different technologies are used. Open source systems like Moodle and Mahara are installed on CentOS Linux systems. Six web servers running Apache+PHP are available to users through HaProxy load balancer that is installed of two separate physical machines running FreeBSD. Two machines are used to eliminate single point of failure. On one web server cron jobs are enabled performing different scheduled tasks in Moodle and Mahara. PostgreSQL is used as a relational database management system and is set up on two servers in master-slave configuration using Streaming replication. NSF provides shared storage for all web servers is installed on primary database server. VLE Merlin also uses two additional servers - VPL server and AirNotifer server. The VPL server enables compilation and execution of programming code through

Moodle activity and AirNotifier provides push notification to Merlin Mobile application. On a daily basis, VLE Merlin is uses by over 8.000 unique users with peek average of over 200 concurrent users. Infrastructure can provide sufficient performance for over 700 users simultaneously taking exams in Moodle with no significant performance degradation.

Since Adobe Connect is Windows application, additional cluster is organized to provide webinar system to the users.
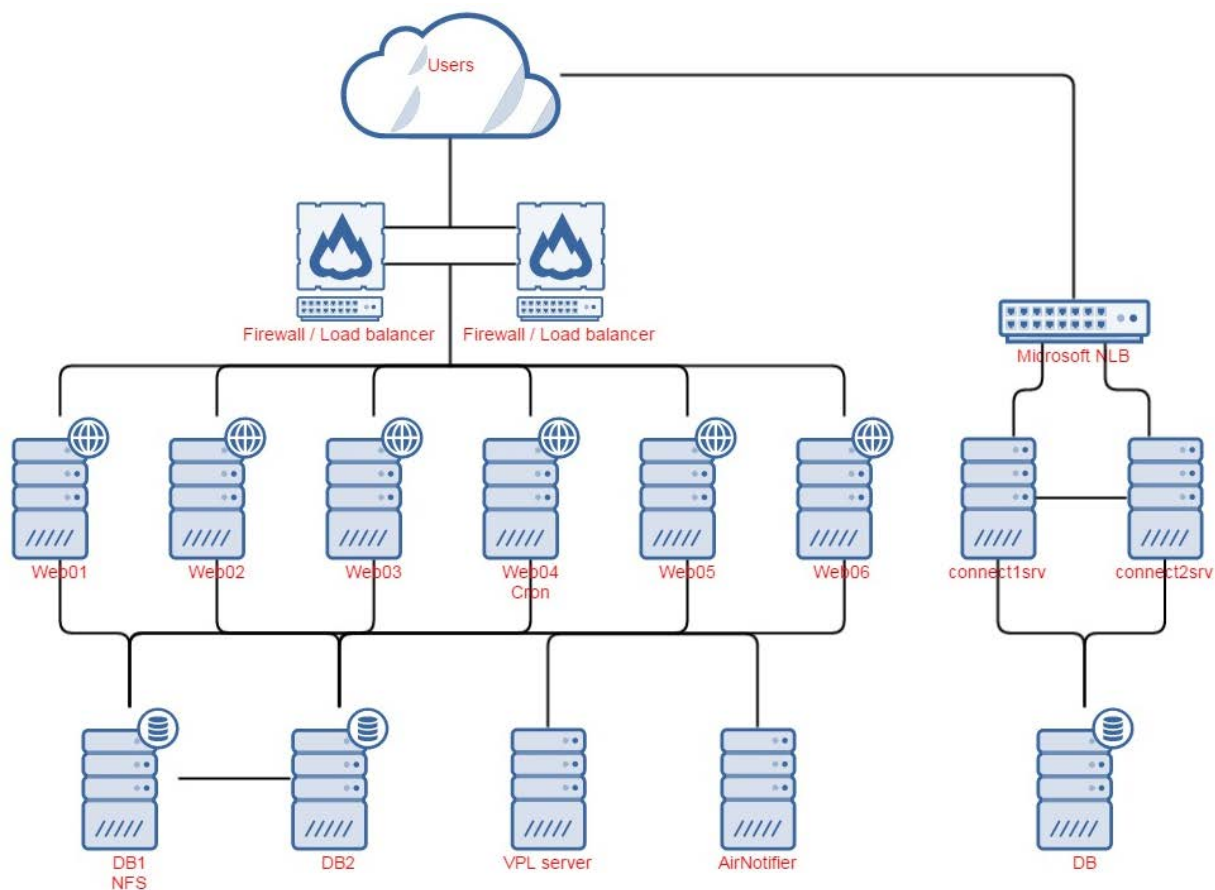

Figure 2 VLE Merlin infrastructure

USER SUPPORT

The use of e-learning technologies is much easier with organized and sustainable support and teachers and students are less reluctant to try them. The Centre has organized helpdesk and consultations, prepared user manuals, animations and training courses (online and face-to-face) in order to ensure that every user gets the most appropriate way of support they need.

The installation of new software versions requires all materials to be up-to-date and verified for new systems.

All user materials are regularly updated and prepared to match the actual version of the software (LMS, e-portfolio, webinars…). The Centre maintains a number of user manuals for all embedded systems as well as a number of short flyers, instructions, FAQs and animations on software usage topics.

Choosing the right tool for the task is probably the most important aspect of teaching because the quality of the final result depends on it. Using e-learning technologies and tools just for the sake of using them will have negative effect on students and their learning experience. The E-learning should support learning process and enrich it so using the right tools the right way is very important. A great effort is made at SRCE to train and support teachers to use e-learning technologies. The Centre is very active in organizing events, workshops and lectures in order to disseminate information about e-learning and raise teachers' awareness on advantages of e-learning and available support.
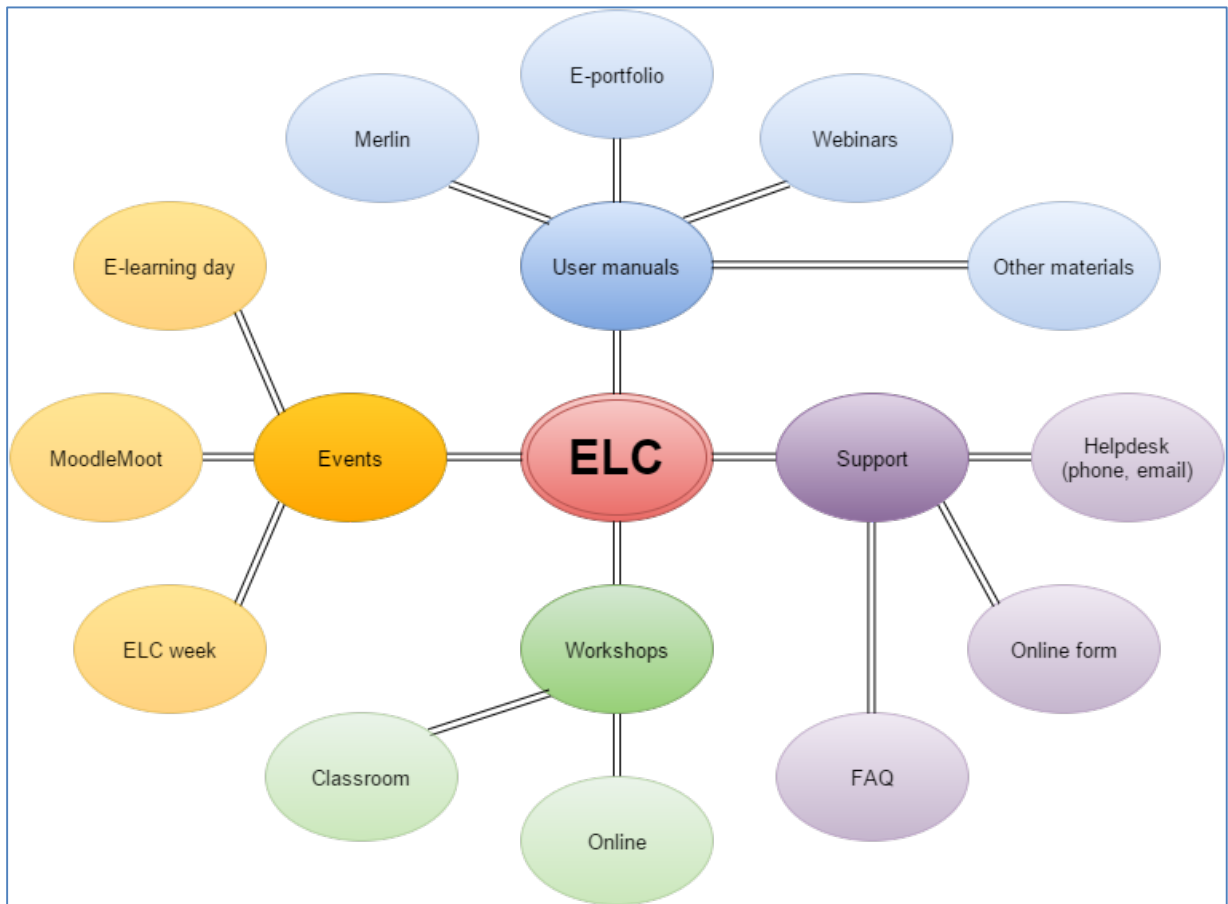
Figure 3 User support at the E-learning Centre (ELC) at SRCE

CONCLUSION

Implementation of ICT and e-learning technologies in teaching and learning process in higher education has become a standard component. But as courses multiply, institutions have to face the issue of providing a good, sustainable support resources to address this issue. Adequate and reliable technical infrastructure to support learning activities is of great importance. Even if using open source software can reduce virtual learning environment implementation costs, maintenance, development and user support will require funds, not only for hardware infrastructure but also for user support. At SRCE, VLE Merlin is considered a vital infrastructure so significant effort is made in all aspects of maintaining and improving it.

Many tasks are still being made to further enhance all aspects of VLE mentioned in this paper. Creating new workshops and learning materials provide better support for growing number of users. Keeping track with new software versions and upgrades is a continuous work as well as upgrading infrastructure. The special emphasis is given to eliminating single points of failure and this process will continue in the future. Current plans for infrastructure improvements involve implementation of database connection pooling, load balancing and automatic failover. Also, by distributing IT resources on two different remote locations, disaster avoidance and/or recovery can be implemented. In this aspect the SRCE has established a second computing location and it is planned that VLE Merlin takes the full advantage of this new infrastructure this year.

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Zvonko Martinović is currently a head of unit at University of Zagreb, University Computing Centre SRCE. Zvonko has worked at SRCE for 7 years. Within his role he is responsible for administration, maintenance and development of e-learning systems at SRCE. Zvonko has expertise in software development and is involved in development and integration of e-learning systems. Previously Zvonko worked at Valicon d.o.o. as software developer.

Zvonko graduated at the University of Rijeka, Faculty of Humanities and Social Sciences.

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Sandra Kucina Softic is the Assistant Director for the Training and User Support at the University Computing Centre SRCE. She is also Head of the E-Learning Centre at the University Computing Centre of the University of Zagreb and the Office for E-Learning at the University of Zagreb, central support units for the implementation of e-learning in higher education. She works on e-learning promotion and implementation at the University of Zagreb, monitoring and coordination of the implementation and providing support as well as advising institutions, teachers and students in implementation of new technologies in learning and teaching processes.

In 2011 she received the Rector's award for successful and motivated work on the development and systematic implementation of e-learning at the University of Zagreb.
In 2013 she was elected the EDEN Executive Committee member and in 2014 she received EDEN Fellow Award.
In 2014 she finished a Master's Programme in Digital Education at the University of Edinburgh, UK.

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Moodle Administrator

Vedran Mušica is currently Moodle Administrator and developer at University of Zagreb, University Computing Centre SRCE, and works at SRCE for last 8 years. He is part of CEU team and is responsible for administration, maintenance and development of Moodle systems at SRCE.

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