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DigiCulture

O2.2 - Technical implementation and Development

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Executive Summary

This document provides an overview of the technical development process behind the Digital Skills for Culture platform, integrated into the UniCampus Platform, which in turn is based on the popular open-source Learning Management System Moodle. It details the server specifications, the current versions of the operating system, middleware, LMS and addons, as well as the functionalities that they are providing. During the development of DigiCulture in the UniCampus environment we adapted more than 50 plugins including the 2 templates and 2 API's developed specifically for the project.

The tools available on the platform are also analyzed from the point of view of their usefulness in creating the courses' content and interactions, and any auxiliary processes involved (like course completion, badge and certificates issuing, re-engagement, etc.)

Objectives of this document

The main objective of this document is to provide readers with a list of technical challenges that the development teams have faced in adapting the aforementioned LMS to the required functionalities, as well as the solutions which were ultimately implemented.

Who is this document for?

This document can prove useful to LMS administrators and/or learning platforms architects, who may seek solutions to similar technical problems as those described here, as well as any person curious to the inner workings of modern online platforms. A basic web-development experience can be useful in better understanding some of these concepts. Familiarity with Moodle further facilitates this goal.

What topics are addressed in this document

The main topics of this document include a brief history and overview of the particularities of the final DigiCulture platform, the extensions which were either found in the official Moodle plugins repository, tested and deployed, or developed from scratch in order to provide the necessary functionality, as well as the main Moodle tools and facilities which were ultimately used in shaping the current form of the platform.

Acknowledgements

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1   Aims and Scope

The aim of this report is to present an overview of the technical considerations regarding the development of the digital culture courses framework. As the most popular open-source learning management system, Moodle needs little introduction, therefore most of this report focuses on changing the default Moodle configuration with the help of custom or third-party extensions, as well as using less common features that the platform provides.

2   Background and rationale

There is a shortage of digital skills in Europe as reported in 2016 in the "European Digital Progress Report EDPR" [1] of the European Commission. The report states that 45% of Europeans have insufficient or no digital skills at all. Based on the Digital Economy and Society Index (DESI) [5] from 2017, there seem to be significant differences between the countries that are partners in this project. Denmark has one of the most advanced digital economies in the EU, while Lithuania and Austria are in the middle, however Romania and Italy have the lowest scores on the DESI scale. Studies performed by the authors in the cultural and creative industries [4], in the last 3 years in different countries showed a large majority of respondents scoring lower or basic level for the 21 digital competences [6]. The use of web, mobile, social and analytical tools permeates most of culture and creative industries, areas which until recently have been reluctant to embrace the use of the new technologies. Eurostat 2017 [2] identifies young adults from the creative industries as the most at risk for unemployment from the 22-36 years old, while noting their lack of entrepreneurial and digital skills.

As part of the DigiCulture Project, we helped create a sustainable and efficient open education program, dedicated to adult learners with low digital skills and low-qualified adults involved in the creative industries sector. This report presents the instructional modelling for an open, online environment dedicated to a training program, based on the Massive Open Online Course model as well as the UniCampus virtual environment [7]. The modelling takes into consideration the existing UniCampus platform, which is further developed in order to integrate the requirements of low digital skills adults, Open Education, e-assessment and a mobile environment. The DigiCulture educational program is fully integrated in the UniCampus as an online component, a blended learning model and easy-to-access features in the mobile app.

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3   Methodology, tools and research

The main research question of this report is: how to best adapt an existing Learning Management System (LMS), namely Moodle, to the specific requirements of non-technical learners, with the purpose of increasing the platform's effectiveness and level of adoption.

To answer this question, a qualitative approach was considered best suited. An exploratory analysis of the features considered essential for the adoption of the platform by low-skilled learners was based on the authors' multi-year experience in designing the necessary tools and the courses themselves, as well as in tutoring said courses.

The vast array of tools made available for the open-source LMS Moodle was trimmed to the necessary minimum, and a large emphasis was placed on the functional usability of the platform from the point of view of the target audience. Starting with the building of a custom graphical interface and continuing with testing and validating a suite of third-party extensions which provide –in part– the stated objective, we designed a simplified version of Moodle, aimed at non-technical learners, with limited digital skills as a whole, and e-Learning experience in particular.

4   Technical description of the UniCampus / DigiCulture platform

The UniCampus platform started as an attempt to provide the first Romanian language MOOC-like Massive Open Online Courses. Development began in 2014, and by 2016 three courses were completed and piloted, with an additional two in advanced planning stages [7].

The platform is based on Moodle, the popular open-source learning management system, which was completed with third-party extensions aimed at complementing and facilitating the learning process, all the while providing course participants with social media connections in line with the constructivist philosophy that Moodle promotes [8].

Since its launch, UniCampus was constantly adapted to the needs of the users (course participants, course tutors, managers, etc.) and many extensions were functionally tested and uninstalled if found to be insufficiently useful. Moodle itself was affected by multiple updates, which were tested and validated inside the development environment, then applied to the production environment.

The environment in which the UniCampus/DigiCulture platform currently operates includes:

- A dedicated Virtual Private Server hosted on a commercial cloud inside the European Union (therefore abiding by the General Protection Data Regulation)
- 3 core CPU / 4 GB RAM / 80 GB storage dedicated hardware resources (with the possibility of upgrading the configuration at any time)
- Software:
  - o   OS: Ubuntu 18.04.5 LTS (GNU/Linux 4.15.0-60-generic x86_64)
  - o   Webserver: nginx v1.14.0

- o Database: MariaDB v10.4.17
- o Middleware: PHP v7.2.24
- o Moodle: version Moodle 3.10.4+ (Build: 20210625)
- Extra activity modules:
  - o Checklist (mod_checklist) version 3.9.0.1 (Build: 2021061200)
  - o Course certificate (mod_certificate) version 3.11 (Build: 2021060800)
  - o H5P (mod_hvp) version 1.22.3 (Build: 2021061100)
  - o OU Blog (mod_oublog) version 3.7 r1 (Build: 2020050800)
  - o Questionnaire (mod_questionnaire) version 3.10.0 (Build: 2020111100)
  - o Reengagement (mod_reengagement) version 3.6.3 (Build: 2020102200)
  - o Virtual programming lab (mod_vpl) version 3.4.3+ (Build: 2021052513)
  - o Wiziq (mod_wiziq) version v2.7-r1 (Build: 2014070202)
- Blocks:
  - o Completion Progress (block_completion_progress) version for Moodle 3.8 onwards (Build: 2021050400)
  - o SocialShare (block_socialshare) version 1.1 (Build: 2015080602)
- Text filters:
  - o Filter Codes (filter_filtercodes) version 2.2.0 (Build: 2021052200)
  - o Generico (filter_generico) version 1.4.11 (Build: 2021010400)
- Atto HTML editor / Atto plugins:
  - o Generic for Atto (atto_generico) version 1.1.1 (Build: 2018090300)
- Enrolment methods:
  - o Auto Enrol (enrol_autoenrol) version 2.3.2 (Build: 2021061700)
- Admin tools:
  - o Certificate manager (tool_certificate) version 3.11 (Build: 2021060800)
- Course formats:
  - o Collapsible Topics format (format_collapsibletopics) version 3.9 (2020061700)
  - o Edwiser course formats (format_remuiformat) version 1.0.9 (2020092900)
  - o Tiles format (format_tiles) version 3.9.0.13 (2020080613)
- Reports:
  - o Ad-hoc database queries (report_customsql) version 4.0 for Moodle 3.9+ (2020121800)
- Themes:
  - o DigiCulture Theme (theme_dc) version 0.0.1 (2019082100) – DEVELOPED BY UPT
  - o UniCampus Theme (theme_uc) version 0.1.1 (2019072500) – DEVELOPED BY UPT
- Local plugins:
  - o Externalize Course Information (local_ci) version 2019121001 – DEVELOPED BY UPT
  - o Static Pages (local_staticpage) version v3.10-r1 (2021010900)
  - o UniCampus FrontPage Helper (local_ucfp) version 2019080800 – DEVELOPED BY UPT

As part of the Continuous Integration / Continuous Deployment – CICD methodology, the platform as well as its components will be constantly updated to their respective latest versions.

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Some of the plugins were not adapted by their developers once the newer Moodle versions were released, which led to broken functionalities. If those features were considered crucial to the platform, they were sometimes replicated by the developer team behind UniCampus.

One such extension is the graphical interface itself, which for the latest Moodle version required a complete rewrite. The current UniCampus theme was therefore entirely developed in-house, with the obvious advantages of complete control over the user interface and experience, as well as the possibility of functional optimizations, which are crucial for any MOOC-like platform catering to multiple concurrent users
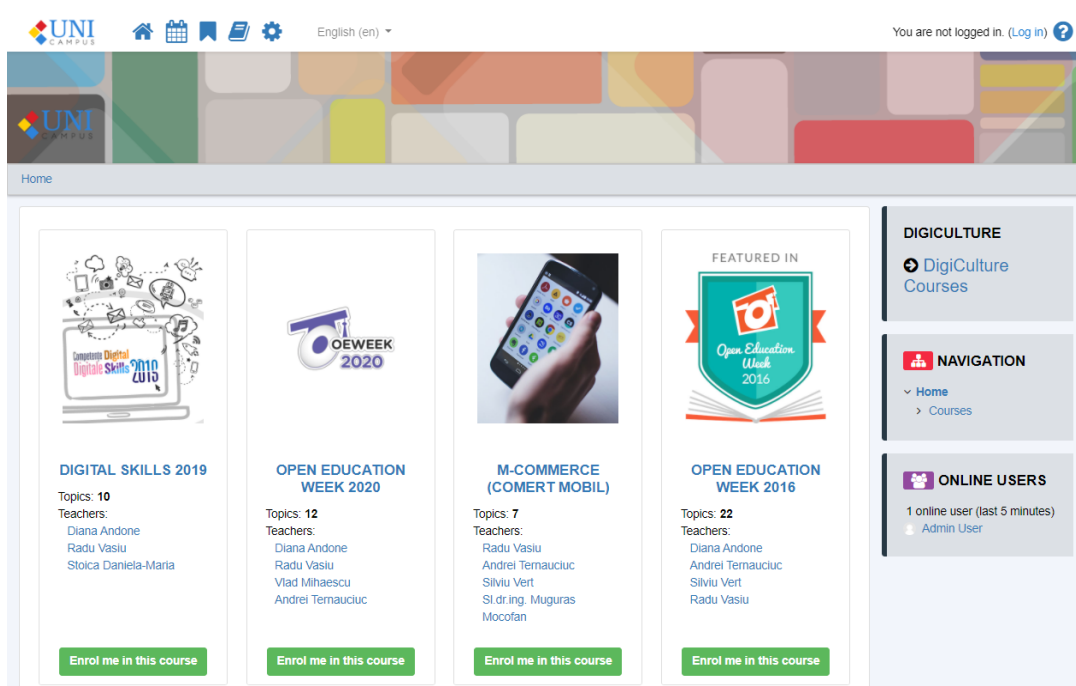
Figure 1. The UniCampus Frontpage

The starting point of the current interface was represented by the Classic theme, which was extended with the appropriate colours and graphical elements of the platform's visual identity.

Aside from simplicity, another directive of the graphical design philosophy was based on redundancy: controls we considered essential were duplicated in a top menu, via graphical icons leading users to a handful of critical aspects, such as the events calendar, the file repository, or the control preferences interface. The regular way of accessing these settings is also present, allowing users familiar with Moodle to continue to use the platform efficiently.

The same information is provided on the presentation website for the UniCampus courses, which is a completely different application than the Moodle-based UniCampus platform. The purpose of this interface is to provide an external perspective on the main platform's content, which suffers from most of the content management systems' shortcomings: adherence to strict mechanisms due to the Moodle framework, unnecessary complex handling of access controls, vulnerability to potential errors in the LMS's source code, etc. A simple presentation website, which reads the information directly from the database, provides

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unauthenticated visitors with all the necessary information needed before committing to the creation of an account with which to enrol in existing courses.

Figure 2. UniCampus presentation website

The existing UniCampus platform thus represented a mature solution, which was built from a standard Moodle standard installation and adapted to provide MOOC-like courses to users from a wide variety of cultural backgrounds.

This is the reason why for the development of the DigiCulture application aimed at hosting instructional courses, we decided to extend the existing UniCampus platform.
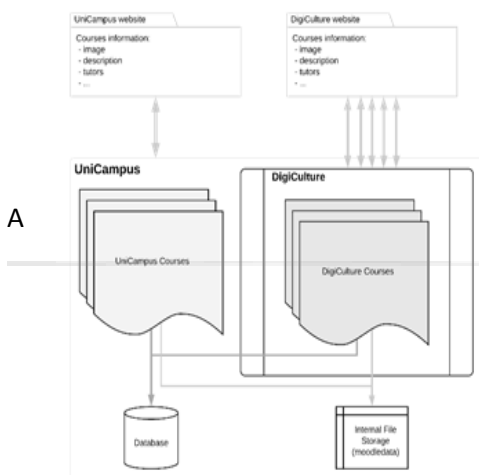
The most obvious difference is the graphical interface. The DigiCulture platform needed to follow the visual identity guides provided by the project, but still adhere to the restrictions of a Moodle theme.

A visually different interface was developed in line with the visual identity established for the DigiCulture Project. The DigiCulture Theme is automatically applied to content (courses) which belong to the DigiCulture Courses category (and existing subcategories).

Figure 3. Integration of DigiCulture with UniCampus
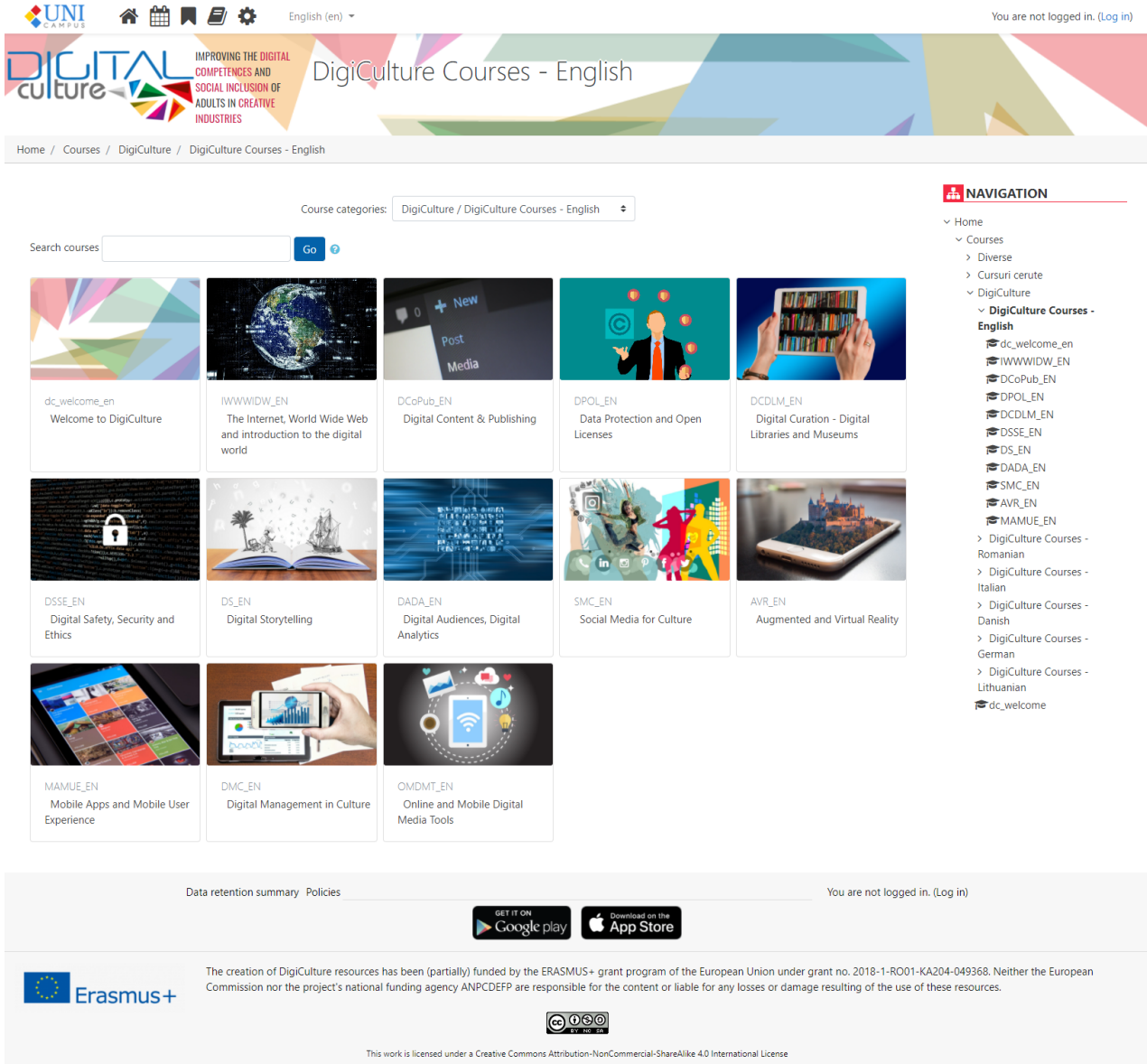
Figure 4. The list of courses available in the DigiCulture category of the UniCampus platform

Stemming from the experience of presenting course previews outside of the main platform, a custom API was developed, in conjunction with the introduction of a series of custom fields for adding specific information to each of the DigiCulture courses. This allows visitors of the main DigiCulture project Website (https://digiculture.eu/en/courses) to consult relevant information before accessing the DigiCulture section of the UniCampus platform in order to enrol in those courses.

Figure 5. Course preview on the DigiCulture Project Website

Another necessary change was caused by the need for more interface languages. While UniCampus was aimed at Romanian users (and therefore provided only Romanian and English language packs), the DigiCulture project has partners from 6 different countries, which prompted the need for six additional language packs; these were provided officially by Moodle via the administration interface.

Figure 6. Language packs management interface

The default sign-up form was supplemented with additional information relevant to the DigiCulture project, by using Moodle's feature of adding custom profile fields, which can be completed during account creation, or at first login.

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All fields have multi-language strings by using the standard Multilanguage Filter available by default in Moodle.

Figure 7. Additional fields for the account creation form

Another important feature was the streamlining of the enrolment process. While Moodle offers a self-enrolment plugin (which was used to allow learners access to the desired section), the workflow of the signup process required that new users who arrived on the platform be automatically enrolled in the Welcome course. This was achieved with the help of the third-party Auto Enrol plugin.

Figure 8. The Auto Enrol plugin (a) and the automated message sent on plugin activation (b)

Because of the need for interaction simplification, as well as a necessary boost to course participant motivation, the default course format was replaced for all DigiCulture courses with the Tiles Format, a third-party extension available in the Moodle official plugin repository [9]. Several other formats were

tested, but ultimately rejected in favour of the Tiles Format which provides an intuitive interface, while separating the content into visually pleasing units.
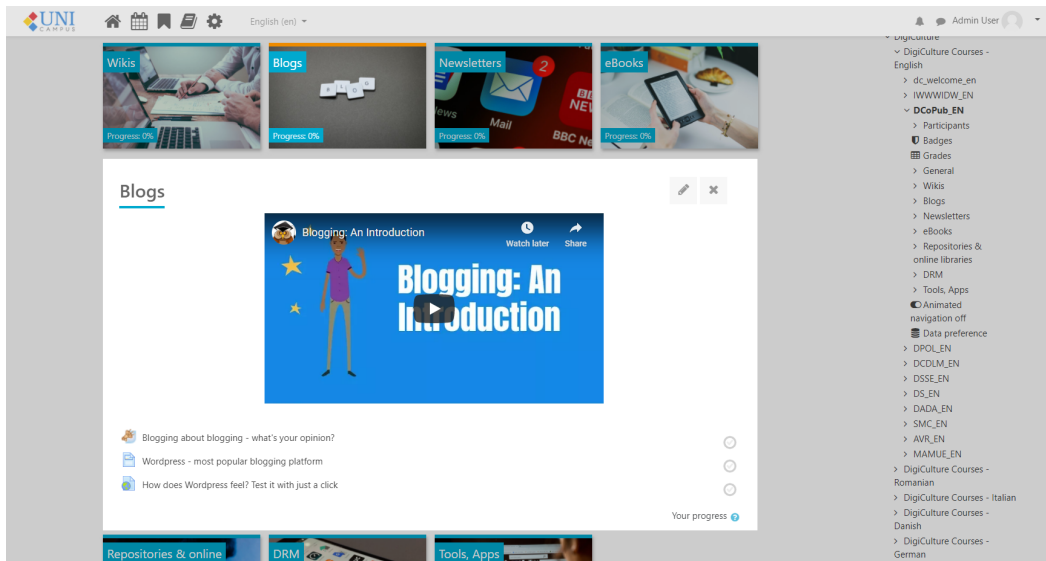
Figure 9. The Tiles course format in a DigiCulture Course

Digital Badges were created and integrated into the Moodle mechanism for awarding users as recognition for their work upon course completion. The default external digital backpack service Badgr [10] was also configured, in order to allow exporting the badges that each user has earned from the UniCampus/DigiCulture platform, as well as import back badges that were claimed elsewhere.

Alongside the default badges available in Moodle, the platform blueprint required the integration of a printable certification mechanism, which was achieved with the help of the Workplace Certificate Manager. This functionality is built-into the Moodle Workplace commercial solution, but is fully compatible with the Moodle LMS, via installable addons. Once installed, this mechanism allowed the configuration of standardized certificates which could be automatically issued upon course completion.

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Figure 10. Certificate configuration (a) and example of certificate automatically issued (b)

And finally, the existing User Policy (in Romanian) was adapted for international users in compliance with the GDPR adopted in the European Union during the summer of 2019.
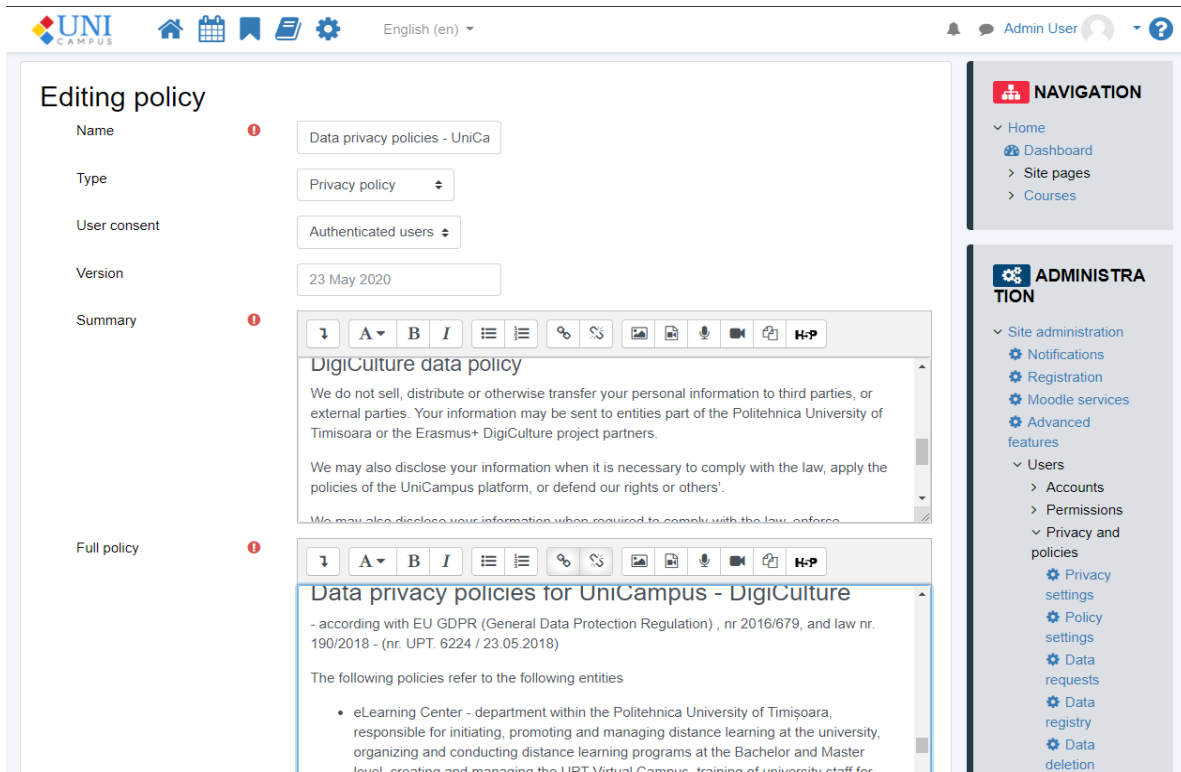
Figure 11. The GDPR-compliant policy for DigiCulture users

6   Development of the DSC courses - technical aspects

Before new learners can access the courses, they are first presented with a Welcome page, which from a technical point of view is a different course. Users are automatically enrolled in this course (using the Auto Enrol plugin) and completion of this course is a prerequisite of finalizing any other DigiCulture course on the platform (and receiving the certification).
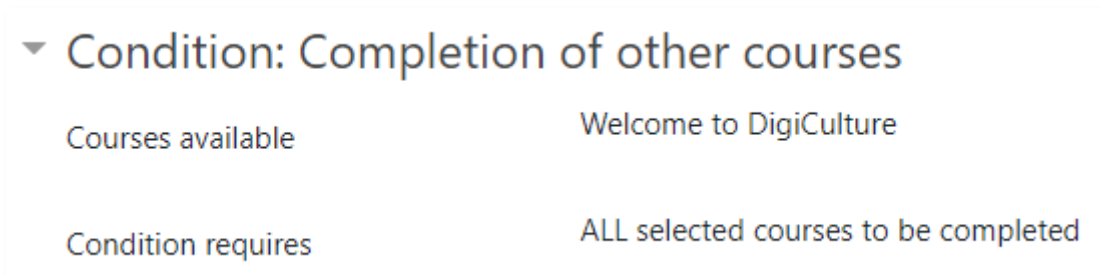
Figure 12. Welcome to DigiCulture course as a prerequisite for completing other courses

The only activity users need to finalize in order to complete the Welcome course is the Previous Background Questionnaire. This course also provides short descriptions to the 13 DSC courses, as well as direct links for easy access.

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Figure 13. The list of courses available on the Welcome to DigiCulture course main page

Each of the courses from the curricula of the DigiCulture project was developed according to a unified template in order to harmonize the learners' experience from an aesthetical as well as functional perspective. Furthermore, according to the Universal Design for Learning (UDL) framework, a set of metadata specifications was devised -aside from the Moodle courses default fields- and completed with information for each of the project courses.

This set includes:

- Course summary and image - Moodle standard
- Course language (forced) - optional
- Developer university or organization and course authors (with name and image) - additional
- Training level, duration, estimated weekly workload - additional
- Course objectives, topics, prerequisites and competencies - additional
- Certification

Many of these fields are made available via an API we developed upon request by the project webpage.
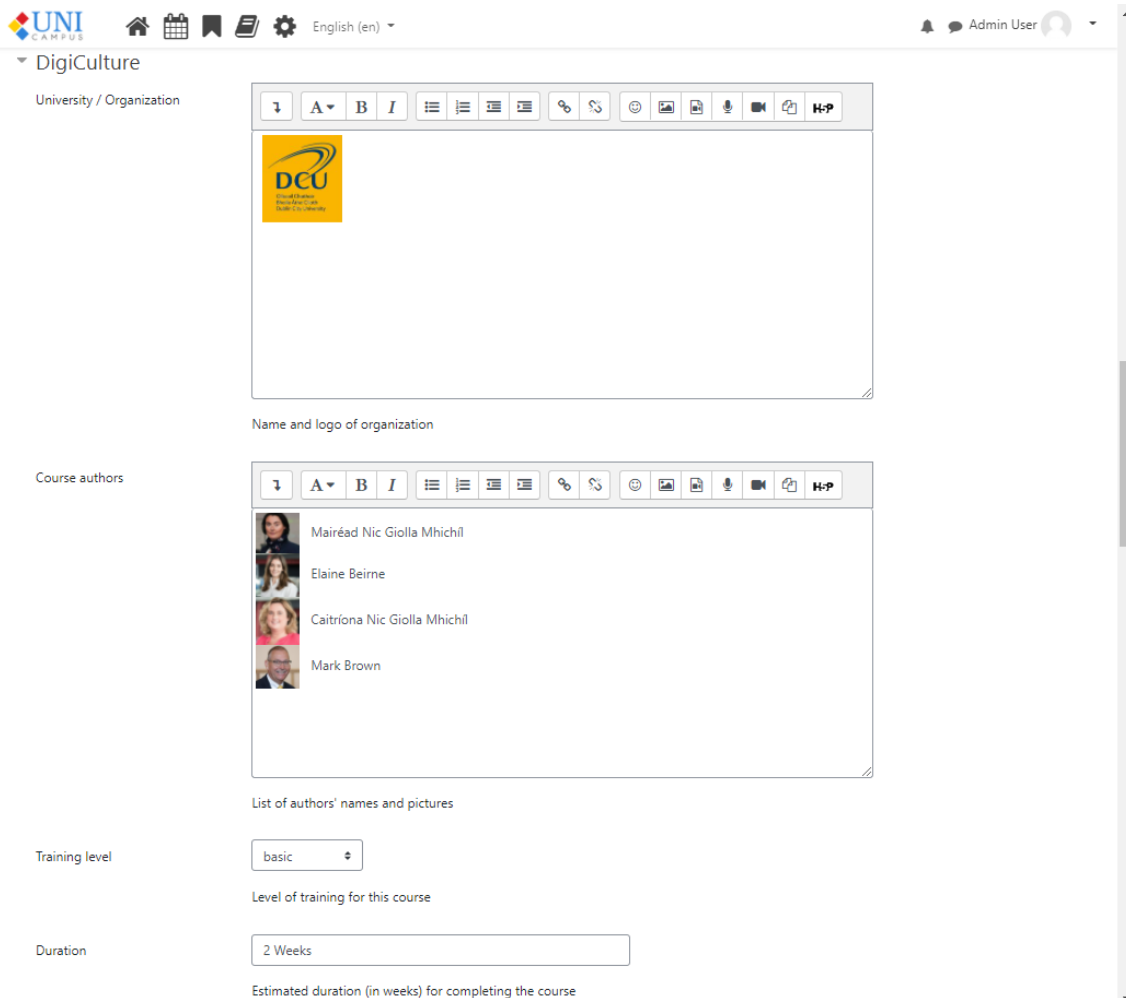
Figure 14. Example of course additional metadata

This information is also presented in the course's main page, using a unified style which was applied with the use of Generico templates.

Generico Templates Admin

Name	Version	Description
DC - Learning Objectives	1.0.0	The Learning Objectives template for DigiCulture courses.
DC - Course Materials	1.0.0	The Course Materials template for DigiCulture courses.
DC - Time To Finish	1.0.0	Time To Finish template for DigiCulture courses.
DC - Course outcomes	1.0.0	Outcomes template for DigiCulture courses.
DC - Course competencies	1.0.0	Competencies template for DigiCulture courses.
DC - Course activities	1.0.0	Activities template for DigiCulture courses.

Figure 15. Generico templates used to display course metadata on each course main page

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Overall progress % 5

Learning Objectives:

This course aims to introduce participants to the key concepts and skills needed to understand, identify and address digital security and ethical issues in both their personal and professional lives.

Competencies:

In line with the Safety dimension of the DigiComp 2.1 Framework, this module will contribute to enhancing participants' digital competencies in the following areas:
1. Protecting devices
2. Protecting personal data and privacy

Outcomes:

On completion of this course, you will be able to:
- Recognise basic terminology relating to digital security
- Identify the main types of malware (malicious software), the main malware dissemination methods, and associated protection measures
- Explain the security challenges associated with wireless networks and operating online
- Demonstrate an understanding of firewalls, password security and other online protection measures
- Assess the risks you or your organisation face and implement a risk management plan
- Recognise the importance of behaving ethically online
- Identify the ethical concerns associated with your work/project

Activities:

- Improve your passwords
- Set up two-factor authentication for your online accounts
- Configure your firewall settings
- Identify and manage your digital security risks
- Engage with ethics in your work/ project

Time to complete the course:

It should take you approximately 6 hours of learning to complete this course.

Figure 16. Course metadata displayed using Generico templates

A variety of course resources and activities types were employed in order to create an intuitive and efficient learning experience. Book-type resources were mostly used, allowing the presentation of content in a coherent manner including text, images or embedded videos.
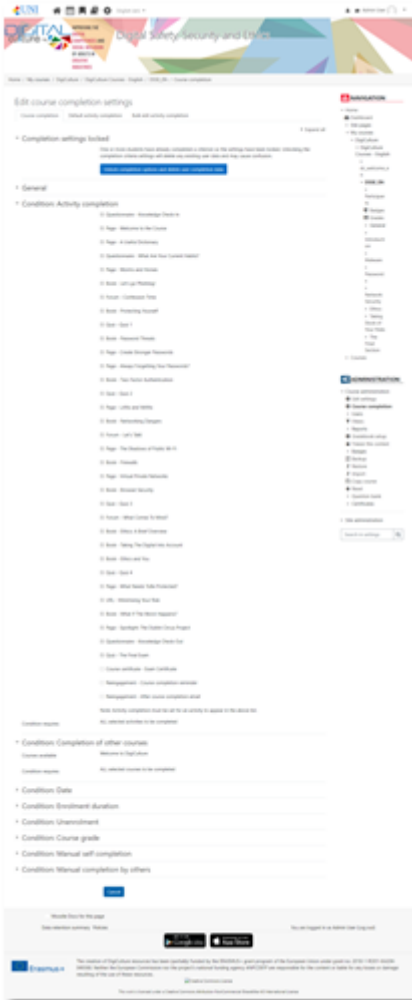
Figure 17. Example of content presented in a book resource format

Discussion forums were used to stimulate discussions and occasionally evaluate learners' activity, and quizzes represented the main type of activity for assessing the learners' progress. The final examination also usually consisted of a self-assessed quiz using multiple choice (randomly selected) questions.

Most of the resources and activities in the courses were configured to record completion, using Moodle's default completion tracking mechanism. Completion progress for each learner was available continuously in the Completion Progress block, as well as by default in the course and topic headers.

Upon completion of all of the required activities (including the final exam, with a passing grade), the course was marked as completed and the course certifications (badges and certificates) were issued.

Figure 18. Various settings for conditions and criteria for course completion

In order to boost course completion, automatic reminders were configured to send emails to learners who have begun but not finished all of the activities in a course. For this we used the third-party plugin Reengagement.

Figure 19. The configuration of the Reengagement plugin as a course completion stimulant

A similar use of ReEngagement was employed to send an automatic message upon course completion, reminding learners to complete a final feedback survey.

7   Conclusions

The DigiCulture Virtual Learning Hub was developed as an innovative multilingual ICT-based environment to promote collaborative learning using connectivist social networking as an instructional method, OERs as the main content, and open digital credentials as recognition and validation of digital skills which can be applied to all ages, genders, cultural backgrounds, and levels of digital education to promote social inclusion at a digital level. Technical challenges were overcome with a combination of third-party plugins, custom extensions as well as the full extent of capabilities available in the Moodle-based learning management system on which the platform is constructed.

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