SMACITE

Enhancing skills for smart city tech

SMACITE

Boosting the technical and non-technical skills and competences of smart cities technicians and engineers

Work Package 4:

MOOC and Virtual Worlds for the upskilling/reskilling of Smart Cities technicians and Engineers

D4.2: MOOC for Smart Cities

Final edition

Co-funded by the European Union

DELIVERABLE FACTSHEET

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2	Ivaylo Gueorguiev, Pavel Varbanov, Violeta Kyurdyan	ESI	10/01/2025	The Final Draft, reflecting the MOOC platform after the pilots
3	Vasileios Gkamas Ioannis Voyiatzis	UPATRAS, UNIWA	17/01/2025	Deliverable review
5	Ivaylo Gueorguiev	ESI	30/01/2025	Final edition

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PROJECT SUMMARY

The project aims to address the skills gap of Smart Cities technicians and engineers, by designing and testing a vocational education and training program that is based on a novel and multi-disciplinary curriculum combining digital skills on Smart Cities enabling technologies, with soft, entrepreneurship and green skills.

The expected project outputs are:

- A Smart Cities competences map and ESCO-compliant Smart Cities job profiles;
- A Smart Cities curriculum combining both technical and non-technical skills and competences and promoting personalized learning pathways;
- Learning resources for Smart Cities enabling technologies and for building the soft, entrepreneurship and green skills of Smart Cities technicians and engineers;
- A diagnostic tool to identify personalized learning pathways;
- A MOOC for Smart Cities enabling technologies;
- Virtual Worlds for building the soft, green and entrepreneurship skills of Smart Cities technicians and engineers.

The main project beneficiaries are Smart Cities technicians and engineers either from the public sector (i.e. municipalities) or enterprises providing Smart Cities solutions, as well as HEI and VET students interested in Smart Cities.

The curriculum was to be tested through 4 national pilots in Greece, Bulgaria, Spain and Italy with at least 160 trainees. The certification of the skills and competences was envisaged to follow a two-fold approach: (a) using micro-credentials to recognize the knowledge and skills gained through the successful completion of each online training module at the MOOC and Virtual Worlds and (b) designing the "Smart Cities Specialization Certification" that would be awarded to those passing online certifications exams with e-proctoring after the completion of the training modules.

The project aimed to create an ecosystem for the co-design and co-development of an innovative curriculum and technology-enhanced learning tools for the upskilling/reskilling of Smart Cities technicians and engineers.

1 Introduction

The development of the SMACITE MOOC on Moodle has been a collaborative and structured process, involving contributions and agreements from all relevant stakeholders at various stages as illustrated in the timeline below (6.2).

1.1 Links and inter-dependencies with other work packages.

The dependencies of WP4 were a key aspect of the SMACITE project's risk management. Managing these interdependencies required careful planning, collaboration, and alignment across multiple work packages and partners.

WP4's foundation relied heavily on WP2, which delivered the Smart Cities competences map and curriculum. This work provided the structural framework and criteria for designing the diagnostic tool incorporated within the MOOC. By collaborating with WP2, WP4 we ensured that content and methodology directly addressed the competency gaps and learning needs identified for Smart Cities professionals. We took into account the WP2's outputs for WP4 to aligning curriculum development with the learning platform's goals, ensuring that the MOOC was both relevant and tailored to its audience.

Simultaneously, WP4 depended on WP3 for the creation of learning resources, which formed the backbone of the MOOC's content. In WP3 the project team developed materials that covered both technical and transversal skills, enabling WP4 to offer a comprehensive learning experience. This collaboration was managed through iterative review cycles, where WP4 was aligned with WP3 to adapt and contextualize these resources for delivery via the MOOC and virtual worlds. Effective communication between the partners ensured that the materials met both the pedagogical and technical requirements of the platform.

The outputs of WP4 were then fed into WP5, which piloted and tested the MOOC and virtual worlds across multiple national contexts. This created a critical feedback loop, where the pilot results informed ongoing refinements to the platform. The practical feedback from the experience gained in WP5 helped us develop the structure, usability, and content of the MOOC. The process not only improved the functionality of the platform but also ensured its alignment with the needs of the users. The project maintained clear communication channels between the work packages, facilitated by regular meetings and collaboration tools. We used a flexible development process to adjust its approach based on feedback from the WP5 pilots. The adaptability was crucial to maintaining momentum and ensuring the project's overall success.

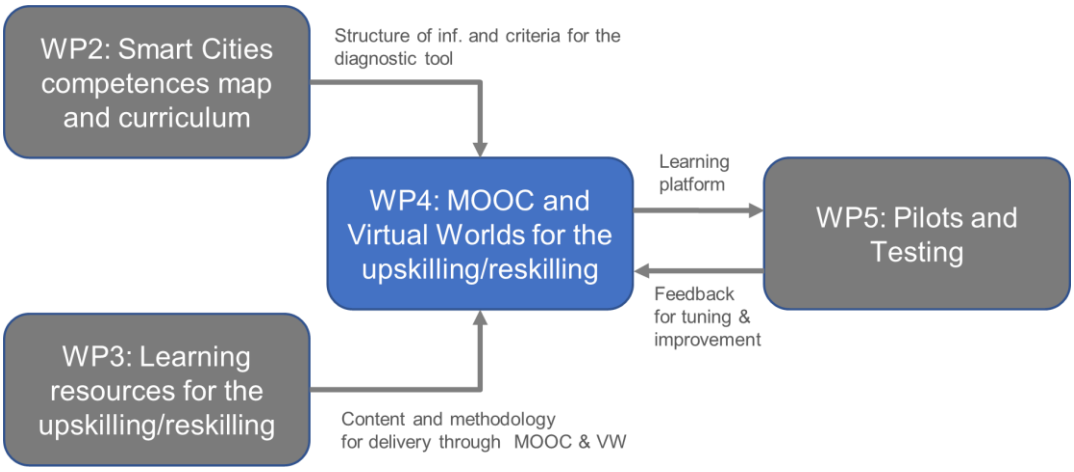

Figure 1 High-level inter-dependencies of MOOC development work package

As a result, we transformed the inputs from WP2 and WP3 into a functional, user-friendly learning platform that was tested and refined through WP5.

1.2 Timeline

In brief, the process included the following key steps and indicative times:

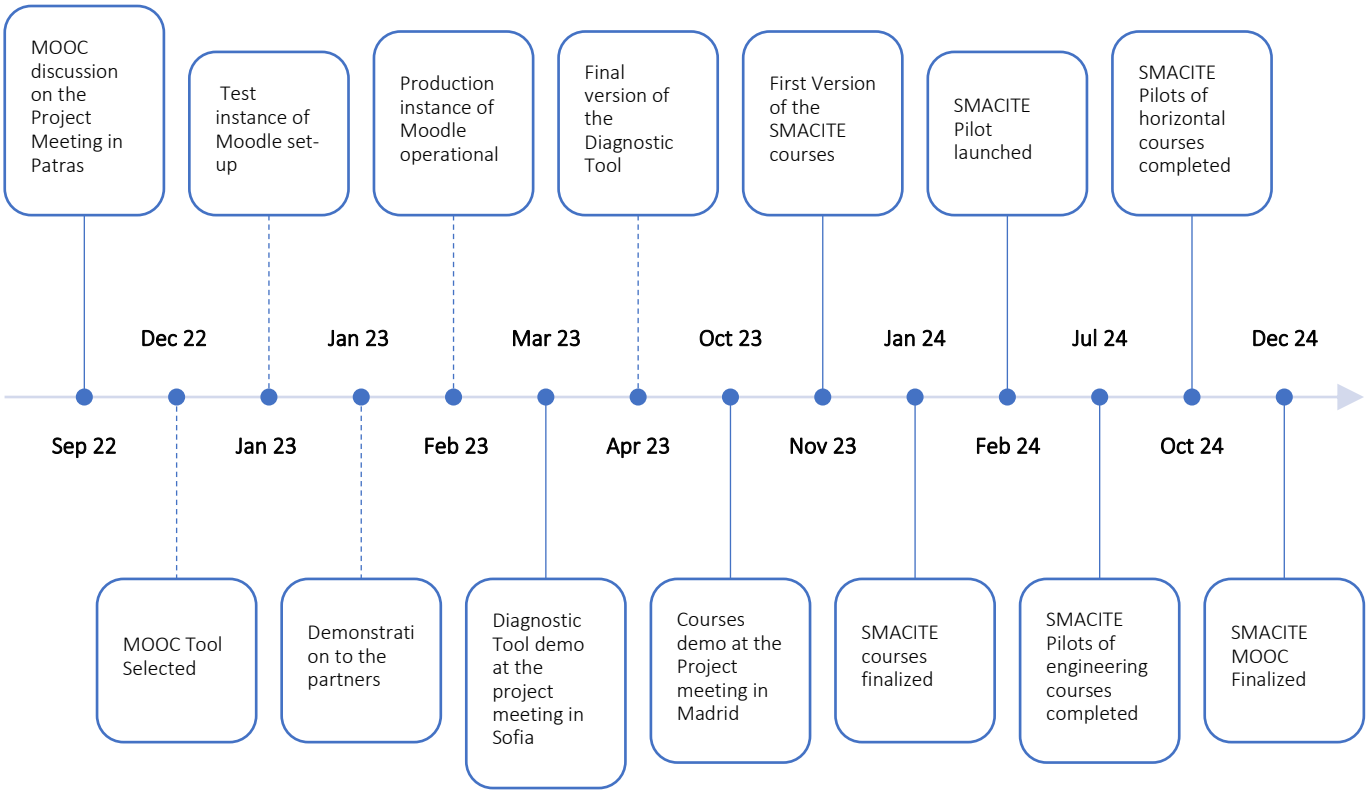

Figure 2 MOOC Development High Level Timeline

- **Sep 22: MOOC Discussion at Project Meeting in Patras.** During the foundation meeting in Patras, the overall process and tool selection for the MOOC were planned and agreed upon. This initial step laid the foundation for the MOOC's development, ensuring all partners were aligned with the project's direction.

- **Dec 22: MOOC Tool Selected.** By December, a significant milestone was achieved with the selection of the MOOC tool. This decision, accepted by the partners, marked a pivotal moment in defining the technological framework of the MOOC.

- **Jan 23: Test Instance of Moodle Set Up & Demonstration to Partners**. ESI CEE took a practical step forward by setting up a test instance of Moodle. This was a key development that allowed partners to visualize and interact with what the MOOC would look like. Subsequently, the MOOC was demonstrated to the partners, who collectively agreed on its utilization for the project.

- **Feb 23: Production Instance of Moodle Operational.** The MOOC Moodle became operational and institutionalized on mooc.smacite.eu, ready for actual deployment and use.

- **Mar 23: Diagnostic Tool Demo at Project Meeting in Sofia.** During the project meeting in Sofia we presented the structure of the content and a demonstrated the Diagnostic Tool. The partners agreed on the presented concepts, indicating a collaborative effort in shaping the MOOC's content and structure.

- **Apr 23: Final Version of the Diagnostic Tool.** We completed the Diagnostic Tool, with the final version being submitted. This tool was pivotal in assessing and shaping the learning paths within the MOOC.

- **Oct 23: Courses Demo at the Project Meeting in Madrid.** A project meeting in Madrid showcased the training courses. This included discussions and agreements on policies for course structure and formatting, addressing GDPR concerns, and student enrolment processes.

- **Nov 23: First Version of the SMACITE Courses.** The first version of the SMACITE courses was included in the MOOC Moodle, marking the culmination of a year-long effort in developing tailored educational content for the platform.

- **Jan 2024: SMACITE Courses Finalized.** The project team completed the development of all SMACITE courses. This phase also marked the operational readiness of the associated digital badges and certificates, enabling learners to receive tangible recognition for their achievements. The courses covered both technical and non-technical skills crucial for Smart Cities technicians and engineers, adhering to the guidelines set during the platform's initial development.

With these components in place, the groundwork for the SMACITE pilot launch was successfully established.

- **Feb 2024: SMACITE Pilot Launched.** The project team launched SMACITE MOOC platform. The users were able to access to the courses. We started providing continuous support to both students and course tutors, ensuring a smooth performance. The support included dealing with technical issues, facilitating effective use of the Moodle platform, and offering technical guidance.

- **Jul 2024: Completion of Engineering Courses.** Students completed the engineering-focused courses, including associated projects, which was a critical milestone in the pilot phase. The MOOC platform demonstrated its technical reliability, with smooth functionality reported throughout this period.

- **Oct 2024: Completion of Horizontal Courses.** The horizontal courses, designed to develop soft, entrepreneurship, and green skills, were completed. This marked the culmination of the training phase for all course categories. Once again, the platform operated efficiently, with students benefiting from the accessible course design.

- **Jan 2025: SMACITE MOOC Finalized.** The project team refined the platform based on the feedback from course creators, tutors, and participants. We enhanced the badges and certificates, enhanced the structure, and implemented suggested features. This final iteration ensured that the SMACITE MOOC platform is robust, user-friendly, and fully aligned with the project's goals, ready to serve as a sustainable resource for Smart Cities technicians and engineers.

In each step in this collective and iterative process, with every decision and milestone being shaped by the inputs and agreement of partners involved in the SMACITE project, we worked together with other partners. This collaborative approach ensured that the development of the MOOC was not only technologically sound but also pedagogically aligned with the project's objectives.

2 MOOC High-level Requirements and Tool Selection

2.1 Objectives

A primary goal of the project was to create a MOOC that would enhance the skills of technicians and engineers in Smart Cities, focusing on key enabling technologies such as the Internet of Things (IoT), Cloud Computing, and Big Data. While numerous MOOCs already cover these technologies, our online courses aimed specifically to address their application within the context of Smart Cities, tailored to meet the professional requirements of technicians and engineers in this field.

This chapter consolidates the findings of desktop research that led to the recommendation of the most appropriate MOOC LMS platform. The findings guided the development of a diagnostic tool under Task 4.1 related to the training needs of Smart Cities' technical workforce. Furthermore, they determined the technology to use in Task 4.2's objective to design and provide a MOOC focused on training for Smart Cities' enabling technologies.

These findings also assisted the project consortium in choosing the type of LMS (open-source vs. subscription-based) that aligned with the educational needs of our target audience. The selected platform had to offer a range of features and capabilities related to content and learning management system. It had to ensure it met the learners' needs and facilitated a practical, hands-on learning experience.

2.2 High-level Requirements

The requirements for the platform were derived from the project proposal and were outlined as follows:

- The platform should facilitate content management presented into modules and displaying it in various formats such as text, embedded documents, videos, and quizzes. This content should be manageable and user-friendly.
- It should enable user management across different roles, including system administrator, content administrator, student, among others, and provide tools for tracking users' learning progress.
- Compatibility with virtual world platforms through sign-on integration was considered as beneficial.
- The platform must be efficient to support sustainability, which includes ease of content management, administration, and user support. Efficiency was judged by the operational costs and the administrative effort required. Preference was given to platforms already successfully utilized by consortium members.

- The platform's sustainability over the next six years was crucial. There should be a reasonable expectation that the platform will remain viable and supported in the market for at least five years after the completion of the project.

The evaluation scale for the platforms was as follows:

- Exceeds project needs: The platform not only meets the selection criteria but also offers additional features that could benefit the consortium.
- Satisfies project needs: The platform meets all the selection criteria.
- Partially satisfies project needs: The platform meets most criteria with some non-critical shortcomings.
- Does not satisfy project needs: The platform fails to meet the selection criteria.

Assessment of the platforms was based on data from the platforms' websites and evaluations from third parties. Researchers could also create demo accounts for a hands-on analysis. Initial research and consultation with the consortium focused on experiences with MOOC LMS platforms that were open-source or Software as a Service (SaaS). Commercial on-site platforms were not considered due to their significant cost, which was beyond the project's budget. The list of platforms included the top three Open Source LMS options for creating online courses as identified by IT'S FOSS[1]:

- Moodle
- Forma LMS
- Open edX

Consortium members reported familiarity with Moodle and Open edX. Additionally, we reviewed the top three systems recommended by eLearning Industry:

- Talent LMS
- iSpring LMS
- Talent Card

Given that Talent Card is exclusively a mobile platform and does not support PC use, and considering the technical demands of Smart Cities content and PC-only Virtual World modules, we concluded that the LMS platform must be PC-compatible. Consequently, Talent Card was not considered further. The project team carefully reviewed and tested each platform and decided to implement Moodle. The conclusions of the analysis and selection is provided in the following table.

[1] https://itsfoss.com/best-open-source-lms/

2.3 Platform evaluation

We present the summarized results in the following table. The results are based on a thorough desktop review, online references, evaluations, and consortium members' experiences with the platforms.:

Platform	Content Management	User Management	Sign on Integration	Efficiency	Sustainability	Note
Moodle	Exceed	Exceed	Satisfy	Satisfy	Exceed	Widely used by consortium partners.
Forma LMS	Exceed	Exceed	Satisfy	Partially Satisfy	Satisfy	
Open edX	Exceed	Exceed	Satisfy	Partially Satisfy	Exceed	Noted for being challenging to manage, requiring significant effort.
Talent LMS	Exceed	Satisfy	Satisfy	Partially Satisfy	Partially Satisfy	Maintenance and fees post-project could jeopardize sustainability.
ISpring LMS	Exceed	Satisfy	Satisfy	Does not Satisfy	Partially Satisfy	Project budget constraints make the platform's fees unaffordable.

Consequently, Moodle emerged as the most suitable platform for the SMACITE Project, aligning closely with project requirements. This evaluation was specific to the SMACITE Project and did not aim to reflect the overall quality of the other platforms or their potential suitability for different projects or objectives.

3 Deployment of the SMACITE MOOC Platform

We considered the deployment method equally important as the platform's content and design. After careful consideration, Bitnami LMS powered by Moodle™ LMS on Amazon Web Services (AWS) was chosen as the preferred hosting solution.

This decision was influenced by several critical factors that aligned with the project's objectives and operational requirements.

Security and Compliance

AWS offers a comprehensive security model that is continuously updated to address emerging threats. The SMACITE MOOC platform benefits from AWS's security protocols, ensuring data protection and regulatory compliance that might be difficult to maintain on a self-hosted server. AWS has compliance certifications and adherence to privacy standards that are critical for protecting user data, a responsibility the SMACITE project takes seriously.

Cost-Effectiveness

Pay-as-you-go model, provided by AWS, appears to be a cost-effective solution by eliminating these ancillary expenses. The ability to select specific services and scale them as needed ensures the SMACITE project only pays for what it uses, optimizing the budget. Once the project is completed, we will continue to maintain the platform for at least four years.

Deployment Speed and Operational Efficiency

Bitnami LMS powered by Moodle™ LMS on AWS allows for rapid deployment, which accelerates the project launch timeline. Instances that are pre-configured and vetted reduce the time and expertise needed to set up and maintain the platform. Self-hosted servers, conversely, require extensive setup and testing, which can delay the project and increase the risk of deployment issues.

High Availability and Disaster Recovery

AWS's infrastructure is designed for high availability, with data centers in multiple geographic locations. This ensures that the SMACITE MOOC platform is accessible to users worldwide, with minimal latency.

Maintenance and Support

Innovation and Integration AWS offers a suite of tools and services that encourage innovation, such as machine learning and analytics, which can be leveraged to enhance the SMACITE MOOC platform. These advanced services are readily integrated, which is not as easily achievable with a self-hosted server.

Conclusion

The decision to host the SMACITE MOOC platform on Bitnami LMS powered by Moodle™ LMS in AWS was rooted in strategic considerations of scalability, security, cost, speed of deployment, availability, and the support infrastructure. This cloud-based solution stood out as a superior option when compared to the alternative of self-hosted servers, offering the SMACITE project a robust, flexible, and future-proof foundation for delivering high-quality educational content to Smart Cities technicians and engineers.

Installation and Configuration of Moodle on AWS

The installation and running of Moodle on AWS via the Bitnami LMS solution followed a series of methodical steps to ensure a smooth deployment and operational stability as outlined below:

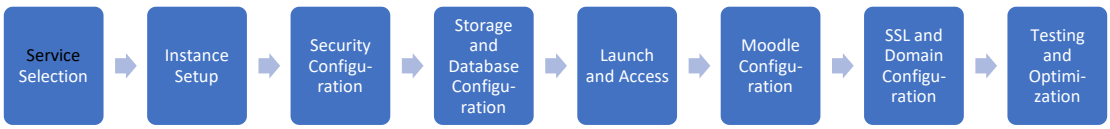

Figure 3 steps of installation of MOOC on AWS

Back up on premises computer systems

The deployment of the SMACITE MOOC platform on AWS using Bitnami LMS powered by Moodle™ LMS was complemented by maintaining and backing up the MOOC on on-premises computer systems. This dual-backup strategy provided resilience and allowed for testing and validation during the development and pilot phases.

Regular backups from the AWS to on-premises systems ensured that the backups were up-to-date and available during pilot evaluations.

Once the pilot phases demonstrated the system's operational stability, the MOOC transitioned exclusively to the AWS infrastructure.

This strategic progression from backing up on on-site systems to complete AWS reliance ensured the SMACITE MOOC platform was robust, reliable, and capable of supporting its educational mission for at least five years after the project was completed.

4 Selection of a Theme

4.1 Appearance

The appearance is important for the usability and effectiveness of the MOOC e-learning platforms. The Module's themes determine the visual appearance, navigation structure, and general usability. Moodle has a visual interface with touch-sensitive functions that make the browsing on mobile phone responsive and highly interactive. We had to select a theme that aligned well with the project's objectives and target audience. Three themes were considered: Boost, Adaptable, and Fordson.

We assessed the themes using the following criteria:

- usability and navigation
- responsive design
- customization and branding
- technical considerations and support, and
- the overall user experience they offer.

Sample views of the Themes is shown below:

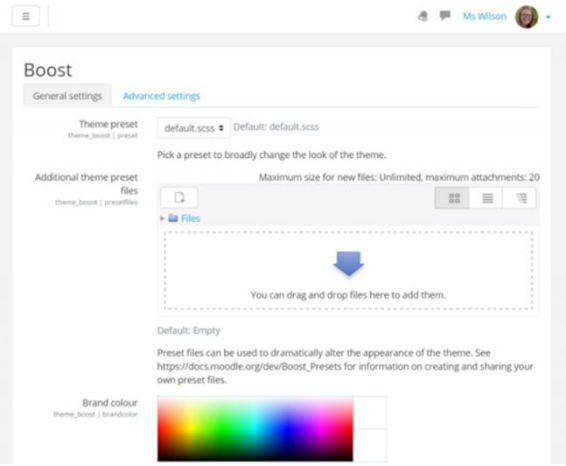

Figure 4 Boost theme sample

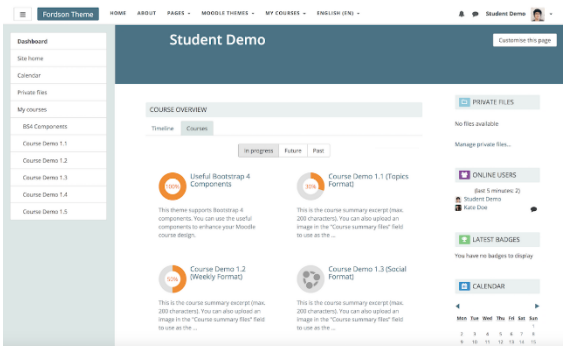

Figure 5 Fordson theme sample

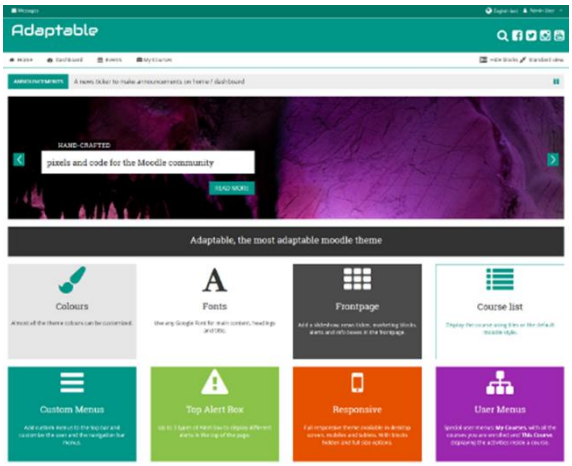

Figure 6 Adaptable theme sample

4.2 Selection

We selected the Boost theme for its simplicity, alignment with Moodle's core updates, and out-of-the-box readiness.

The theme provides an optimal balance of usability, technical excellence, and aesthetic appeal, ensuring that the platform is user-friendly, accessible, and engaging for the target audience of Smart Cities technicians and engineers.

A sample screenshot below shows the SMACITE MOOC homepage. The layout is simplistic, allowing users to easily navigate the available Smart Cities Engineers and Technicians course categories. The icons and sections allow learners to locate relevant content quickly.

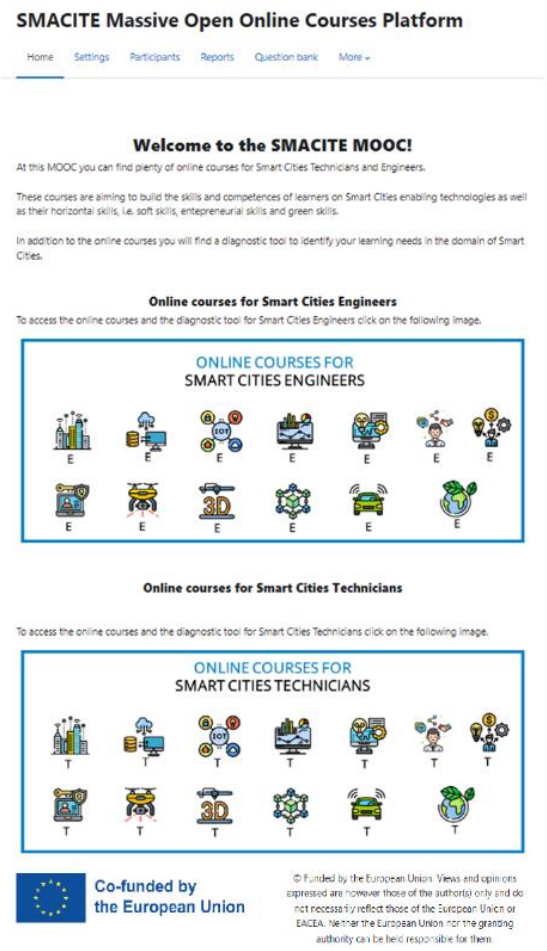

Figure 7 Screenshot of the home page

The **screenshot** of a sample course page for the module "Introduction to Cloud Computing." The design demonstrates clarity, with a structured table of contents on the right side for seamless navigation between sections. The content is presented visually engaging with text, video, and images. The platform maintains a consistent design that aligns with the Boost theme's simplicity and ease of use philosophy.

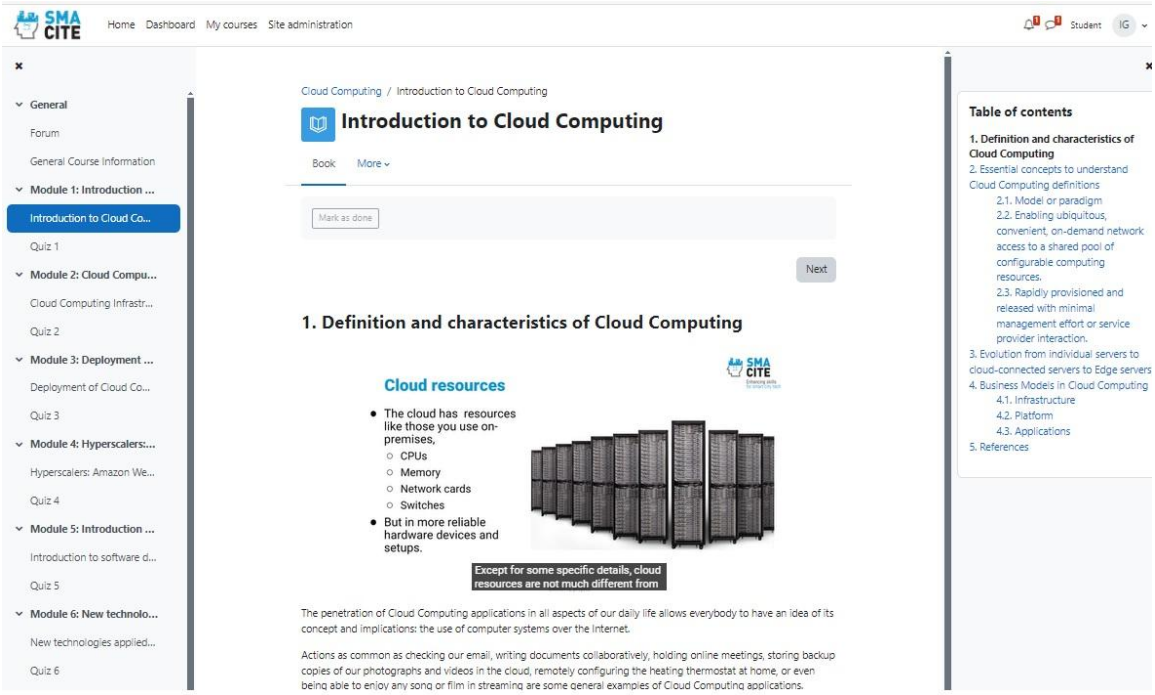

Figure 8 Screenshot of a sample page with integrated video and subtitles.

5 MOOC Roles

We have set up different roles for the SMACITE MOOC platform on Moodle to ensure effective operation, secure content management, and governance. The roles and their key characteristics are listed below:

Manager

Purpose: Organizes courses and manages users.

Permissions:

- Access to most administrative settings, excluding technical site configurations like plugin installation.
- Can create, delete, and modify courses.
- Can assign roles to users.

Course Creator

Purpose: Develops and sets up new courses for the platform, ensuring they are aligned with project objectives.

Permissions:

- Can create courses and assign teachers.
- Limited to the courses they create.

Teacher (Editing Teacher)

Purpose: Facilitates learning by managing and delivering course content, interacting with students, and assessing performance.

Permissions:

- Full access to all features within their assigned courses.
- Can edit, add, or delete course materials.
- Can grade assignments and provide feedback.

Non-Editing Teacher

Purpose: Supports teaching activities within assigned courses but cannot modify course content or settings.

Permissions:

- Can view and grade student submissions.
- Cannot create or edit course activities or materials.

Student

Purpose: Learners enrolled in courses to access educational content, complete tasks, and achieve certifications.

Permissions:

- Access to course content, including videos, assignments, quizzes, and forums.
- Can submit assignments and participate in discussions.

Guest

Purpose: Allows users to view limited content without enrollment or active participation in courses.

Permissions:

- Restricted to view-only access for publicly available content.
- Cannot submit assignments or participate in discussions.

Authenticated User

Purpose: Represents all logged-in users with access to general platform features.

Permissions:

- Basic access to the platform's homepage and dashboard.
- No course-specific permissions unless explicitly enrolled.

Authenticated User on Site Home

Purpose: Accesses the site homepage for general resources or platform-wide announcements.

Permissions:

- View-only access to the site home dashboard.
- Cannot modify content or enroll in courses.

Data Protection Officer

Purpose: Ensures compliance with data protection regulations, such as GDPR, and oversees the secure handling of user data.

Permissions:

- Access to user data and logs necessary for compliance monitoring.

- Permissions to address data-related requests (e.g., access, deletion, or anonymization).

Editor for DT (temporary role)

Purpose: Temporary role for modifying and updating specific fields within the platform.

Permissions:

- Access to tools or areas related to the specific field functionality.
- Restricted permissions to modify only relevant components.
- Depending on their expertise and the platform's needs, one person can have multiple roles.

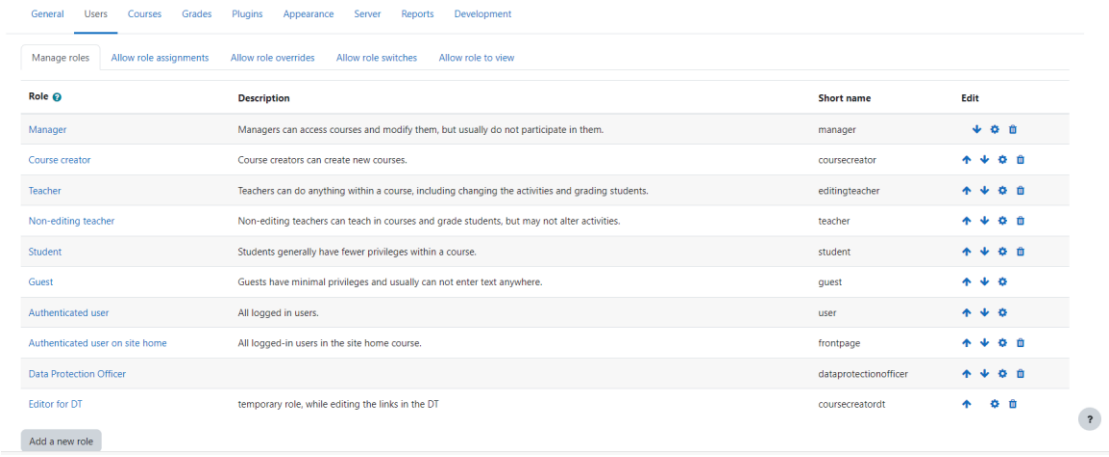

Figure 9 Screenshot of the roles management menu

6 Using categories to structure the content

Using categories in Moodle to structure courses is highly beneficial, especially in complex learning environments like the SMACITE project. This structured approach enables efficient course management and enhances the overall user experience and effective reporting.

Initial Structure Developed for the SMACITE Project

The initial structure for the SMACITE project in Moodle used categories and sub-categories to create a clear and functional course organization:

- **Diagnostic Tool Category:** This includes the Diagnostic tool resources for course self-assessing the training needs of users, which is crucial for personalizing their learning journey.
- **Smart Cities Engineers Category:** A primary category for courses specifically designed for Smart Cities engineers.
- **Courses on Digital Skills Sub-Category:** Focuses on digital technology and software skills pertinent to Smart Cities engineers.
- **Courses on Horizontal Skills Sub-Category:** Covers broader, transferable skills such as communication.
- **Smart Cities Technicians Category:** Tailored for courses aimed at technicians working in Smart Cities.
- **Courses on Digital Skills Sub-Category:** Similar to the engineers' category but likely adjusted for the practical, technical skills needed by technicians.
- Courses on Horizontal Skills Sub-Category: Focuses on general skills that support technicians in their roles.
- **Support Category:** courses or resources for technical support and user guidance.
- **Demo Category:** Used for demonstration purposes and showcases how courses are structured and how to navigate the system effectively.

By using this structure, we enabled users and learners to easily find and engage with the courses most relevant to their roles or professional development. This organization enhances the learning experience, streamlines administrative tasks, and supports the project's overall educational goals.

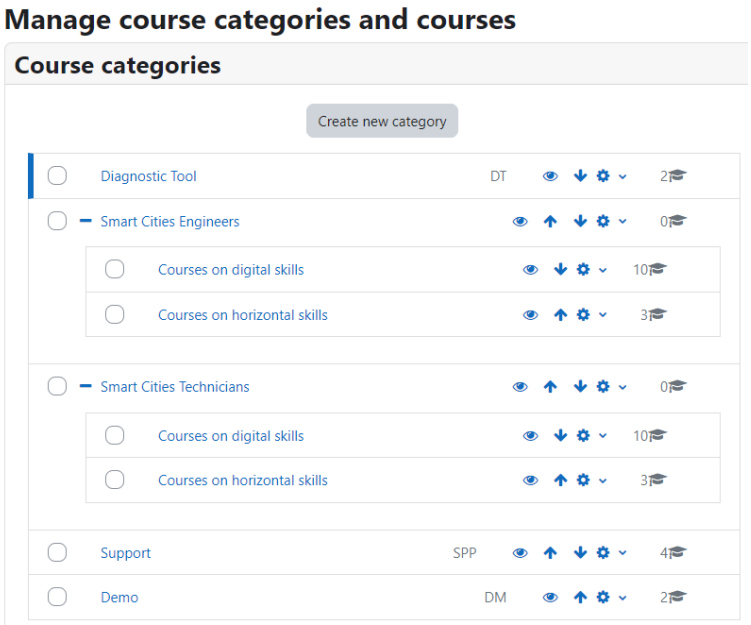

Figure 10 Screenshot of categories organization

7 GDPR

We installed a specific model to maintain compliance with the General Data Protection Regulation (GDPR). The steps were designed to ensure the protection and privacy of user data in accordance with GDPR guidelines.

1. **Updating to the Latest Version**: The team updated to the latest version, as recent updates included enhanced privacy and data protection features in line with GDPR requirements.
2. **Configuring Privacy Settings**: This included configuration of privacy settings. Data consent, export, and deletion were adjusted to align with GDPR's user consent and right-to-access principles.
3. **Creating a Data Protection Policy**: We documented and used a data protection policy in Moodle. The policy included how user data would be collected, stored, and protected, providing transparency as GDPR requires.
4. **Implementing User Consent Mechanisms**: Mechanisms for obtaining and recording user consent were set up. Users are now required to give explicit consent for collecting and using their data, a key requirement of GDPR.
5. **Enabling Data Portability**: We enabled the GDPR functionalities so users can request and receive a copy of their data, complying with the GDPR's data portability rule.
6. **Setting Up Data Deletion and Anonymization Processes**: Procedures were established for the deletion or anonymization of user data upon request or when it is no longer needed, respecting the user's right to be forgotten.
7. **Testing the process**: The functionalities were verified and validated to be sure that they work correctly.

Moodle was successfully set up to maintain GDPR compliance, ensuring the privacy and protection of user data and aligning with legal requirements in the European Union.

8 Installed Moodle Plugins

Plugin integration enhances the functionality of the Moodle platform. The default installation includes key plugins that are fundamental to course management and interaction, while additional plugins offer specialized capabilities to meet the specific needs of the SMACITE MOOC.

Key Plugins in Default Installation of Moodle 4.1:

- **Quizzes**: enable teachers to create different types of quizzes to verify students' knowledge.
- **Forums**: support communication between students and teachers
- **Gradebook**: tracks and displays students' performance across different courses and activities.
- **Assignment**: allows instructors to create assignments, collect student work, review it, and provide grades and feedback.
- **GDPR**: Ensures compliance with the European Union's General Data Protection Regulation (GDPR) within the Moodle platform.

Additional Plugins Installed for SMACITE MOOC:

- **Custom Certificate (mod_customcert)**: Offers the ability to design certificates with different layouts, adding images, text, and course data. It's crucial for SMACITE MOOC to issue personalized certificates, reflecting course completion or achievements with specific branding elements.
- **Questionnaire (mod_questionnaire)**: Beyond basic surveys, this plugin supports a range of question types, including multiple-choice, open-ended, and scales. It's instrumental in collecting detailed feedback from students, which is vital for continually improving the SMACITE MOOC experience.
- **Microsoft Word File Import/Export (Book) [book tool_wordimport]**: This plugin allows complex book resources, including chapters and sub-chapters, to be efficiently managed in Microsoft Word and then imported into Moodle. It streamlines content creation for SMACITE MOOC, particularly for modules that require extensive textual information and formatting.
- **Microsoft Word File Import/Export (Lesson) [local_lesson_wordimport]**: This plugin is handy for lessons that require a narrative or linear flow. It helps create course creators and update structured lesson content, ensuring that the SMACITE MOOC platform can provide engaging and well-organized instructional material.

The integration of these plugins in Moodle for the SMACITE project reflects a commitment to providing a comprehensive, user-friendly, and effective learning environment. The default plugins establish a solid foundation for course delivery and management while the additional plugins bring in customized capabilities essential for the specific requirements

of SMACITE MOOC, such as personalized certification, enhanced feedback mechanisms, and efficient content handling. This combination ensures that the platform is robust and versatile and finely tuned to the needs of educators and learners in the SMACITE program.

9 Users self-enrolment

The self-enrolment process for students in the Moodle platform was organized in a structured and user-friendly manner. It was in compliance with GDPR and provided smooth access to courses.

1. **Self-Registration with GDPR Compliance**: Initially, students were asked to self-register on the Moodle platform. As part of this registration process, they completed a GDPR form. This form was designed to inform students about how their personal data would be used and to obtain their explicit consent in accordance with GDPR regulations.
2. **Distribution of Enrolment Codes**: After completing the registration process and it was confirmed students were eligible to enroll in the desired courses, the admins can send them unique codes for the courses. This is optional, by default courses are open for the students.
3. **Self-Enrolment into Courses**: Students could self-enroll in specific courses of their choice directly or using the provided codes if the teachers decide to control the enrolment process. The enrollment codes ensured that students only accessed the courses relevant to their training needs and qualifications. The enrolment codes helped also to mitigate the risk of potential spammers and scammers to access the courses.
4. **Confirmation of Enrolment**: After enrolling in a course, students receive confirmation of their enrolment.

By organizing the self-enrolment process in this manner, the Moodle platform ensured a user-friendly experience for students while maintaining necessary data protection standards. This process allowed students to have control over their learning journey, from registration to course selection, in a secure and structured online environment.

10 Badges

We designed and implemented badges in Moodle to recognize students' achievements and motivate them to continue and finish their courses.

Key characteristics of the badges are listed below:

- **Awarding Achievements**: Badges can be awarded for a variety of achievements, such as course completion, participation in discussions, or excellence in assignments.
- **Motivation and Engagement**: They motivate learners to engage more deeply with the course material and to be engaged with the learning.
- **Display and Shareability**: Students can put badges on their Moodle user profile. They can share them on specialized social or professional media.
- **Customization**: Badges in Moodle can be customized in terms of design and criteria. Specific criteria are set for each badge, and only when these criteria are met are the badges automatically awarded to the learner.

The SMACITE MOOC function for badges enhanced the student's journey and provided milestones for learning the Smart Cities curricula.

Sample badges

Image	Name	Description	Criteria
	Smart Cities Module 4 Completed	Congratulations! This badge acknowledges your successful completion of the "Planning and deployment of Smart Cities solutions" module. Throughout this module, you have learned about developing implementations within the scope of Smart Cities projects, with a special focus on methodology and continuous improvement.	• ALL of the following activities are completed: ○ "Quiz - Quiz 4" ○ "Book - Planning and deployment of Smart Cities solutions"
	Smart Cities Module 3 Completed	Congratulations! This badge acknowledges your successful completion of the "Technological Solutions" module. Throughout this module, you've learned about several Smart Cities related technologies: sensors, open data platforms, IoT	• ALL of the following activities are completed: ○ "Book - Technological solutions for Smart Cities"

Image	Name	Description	Criteria
		devices, communication protocols and devices and many others.	○ "Quiz - Quiz 3"
	Smart Cities Module 2 Completed	Congratulations! This badge acknowledges your successful completion of the "Cases of success" module. Throughout this module, you've learned about different real-life scenarios where Smart Cities initiatives were applied to real problems in different cities across the world.	• ALL of the following activities are completed: ○ "Book - Cases of success" ○ "Quiz - Quiz 2"
	Smart Cities Module 1 Completed	Congratulations! This badge acknowledges your successful completion of the "Introduction to the Smart City concept" module. Throughout this module, you've learned about the basics of Smart Cities and how this technology is related with IoT, Cloud Computing and standardization organisms.	• ALL of the following activities are completed: ○ "Book - Introduction to the concept of Smart City" ○ "Quiz - Quiz 1"

11 Certificates

The certificates indicate that the students have successfully finished the course and provide links to information about the key characteristics of the course and its curricula. This information is helpful for other educators who can decide to recognize the course completion in their programs. This mechanism serves as a micro-credential process.

Functionality of Custom Certificate in Moodle include:

1. **Customization**: The Custom Certificate plugin we set up and maintained provided high level of customization. Administrators can design certificates that reflect the branding and ethos of the SMACITE MOOC, including the use of logos, specific fonts, colors, and layouts.
2. **Dynamic Data Integration**: The certificates automatically retrieve and display students' data, such as course name, student name, link to course details, and others. Each certificate is personalized and carries relevant information.
3. **Automated Issuance**: Certificates are automatically issued to students who meet predefined criteria, such as completing a course or passing a final assessment. This was efficient and eliminated the possibility of errors.
4. **Verification**: Each certificate included a unique code for external verification of its authenticity. In this way other educators can verify the certificate and accept it for their programs.
5. **Downloadable and Shareable**: Once issued, certificates are downloadable and can be shared by students.

We set up the criteria for earning the certificates based on the objectives of each course within the SMACITE MOOC. The criteria included:

- completing specific course modules,
- achieving required scores on quizzes, and
- completing assigned activities and projects.

Sample certificate is provided in the figure below:

Figure 11 Sample certificate of Smart Cities for Engineers Course

12 Support for the SMACITE Moodle Platform

To ensure that all requests concerning the SMACITE Moodle Platform will be addressed promptly and organized, we established a special process that we presented to and coordinated with all SMACITE Team members. The method of handling platform-related requests was carefully considered to guarantee that it ensures efficient processing of the requests, it is transparent to all partners, and it maintains a record of related communications for future reference and analysis. Here is what the process looked like:

1. **Form submission:** We introduced a single point of contact for all support-related communications – a shared Google form through which users could submit their issues, comments, ideas, or suggestions related to the Moodle platform. The form is accessible at https://forms.gle/pM2bVNWAPWU2wfHr6 . The form collects not only the user's email and name, as well as a brief title, a detailed description of the request, and any accompanying screenshots or videos, but also essential information such as the type of request (issue, improvement suggestion, etc.), urgency (critical to low) and impact ("we cannot perform a project activity without it" to "just an idea to discuss").
2. **Submission confirmation:** Users receive a confirmation email within 30 minutes of submitting a request. The email contains guidelines for further communication.
3. **File Management**: In case users attach any files upon request submission, these files are added to a designated Google Drive folder, ensuring all related documents are stored in an organized and accessible manner.
4. **Ticket Creation**: A ticket is automatically generated in the task management tool once a request is submitted. This helps manage and track the progress of the request.
5. **Google Sheet Record**: This document is a centralized place for tracking and managing requests. Information about all submitted requests is automatically recorded and transparent to all SMACITE Team members. The sheet includes all the details provided by users upon submission of the request. Also, it is regularly updated (automatically) with the status, resolution, and last updated time of each ticket. This ensures transparency and real-time tracking of requests.
6. **Ongoing notifications**: Users receive an email notification each time the status of their request changes. The email provides them with a reference for further communication.
7. **Validation and Closure**: When a solution is ready for validation (i.e. a ticket is moved to the 'Validating' column in the task management tool), a notification is automatically sent to the requester. It includes the resolution of the request, and it invites the requester to validate the resolution within the following seven days. If no objections are received, the ticket is closed (it is moved to the 'Done' column),

and a final notification is sent to the requester, informing them that the ticket is closed.

Benefits of the Process

- **Efficiency**: It is more efficient for users and the support team.
- **Transparency**: The use of Google Sheets to record requests and a task management tool (Kanbanize/Businessmap) to track progress ensured transparency and accountability in handling support queries.
- **Timely Communication**: The request about the status of their queries via automated notifications and confirmations.
- **Record Keeping**: All communications and resolutions were promptly informed were recorded. We were able to review and analyze the collected data.

Submitting a request following the process described above was user-friendly, and it helped the support team manage and respond to queries in an organized and timely manner.

13 SMACITE Moodle structure and usage

This chapter presents the content structure of the MOOC tools and courses developed during the MOOC creation process and verified through the pilot phase. Detailed descriptions of each tool and course are provided in their respective deliverables, as listed below. The MOOC content might be further developed after the pilot to meet the needs of the students further.

These deliverables collectively represent the foundational content of the MOOC. They are designed to address both the technical and non-technical training needs of Smart Cities professionals, ensuring a comprehensive learning experience. Together, they offer a deeper understanding of the materials included in the MOOC platform. The deliverables are as follows:

- **D4.1: Diagnostic Tool to Identify the Training Needs of Smart Cities Technicians and Engineers**

  This deliverable describes the MOOC resource related to Diagnostic Tools. These tools are designed to assess the unique training needs of learners, specifically Smart Cities technicians and engineers, and to support the creation of personalized learning pathways.

- **D3.1: Learning Resources for Smart Cities Key Enabling Technologies**

  This deliverable outlines a set of Open Educational Resources (OER) focused on foundational enabling technologies for Smart Cities. It describes the Courses on digital skills

- **D3.2: Learning Resources for Soft Skills Development**

  These resources are designed to enhance the soft skills of Smart Cities technicians and engineers included in the Courses on horizontal skills section. The OER are tailored to foster professional growth in collaboration and communication abilities.

- **D3.3: Learning Resources for Entrepreneurship Skills Development**

  This deliverable includes a curated set of OER aimed at cultivating entrepreneurial skills among Smart Cities technicians and engineers included in the Courses on horizontal skills section. The resources emphasize innovation, leadership, and business acumen within the Smart Cities domain.

- **D3.4: Learning Resources for Green Skills Development**

This deliverable represents a collection of OER developed to advance the green skills of Smart Cities professionals included in the Courses on horizontal skills section. These resources address sustainability, environmental awareness, and eco-friendly technology applications.

13.1 Diagnostic Tools

The Smart Cities Diagnostic Tool is structured as a series of interactive lessons within the Moodle platform (1 series for Engineers and 1 for Technicians), designed to assess learners' training needs and guide them in selecting appropriate learning pathways. Detailed information about this tool is provided in Deliverable D4.1: Diagnostic Tool to Identify the Training Needs of Smart Cities Technicians and Engineers.

The Diagnostic Tool for Engineers was utilized by 129 students, while the equivalent tool for Technicians was used by 76 students. Many of these learners engaged with two or more modules to self-assess their skills, enhance their knowledge, and explore curricula relevant to the associated courses. A significant proportion of students accessed the tool immediately after the platform was launched at the start of the pilot phase. The platform demonstrated stable and reliable performance from the beginning of the pilot and maintained its robustness throughout and beyond the testing period.

This diagnostic tool served as a foundational resource, enabling learners to identify areas for upskilling and connecting them to specialized training in various Smart Cities domains.

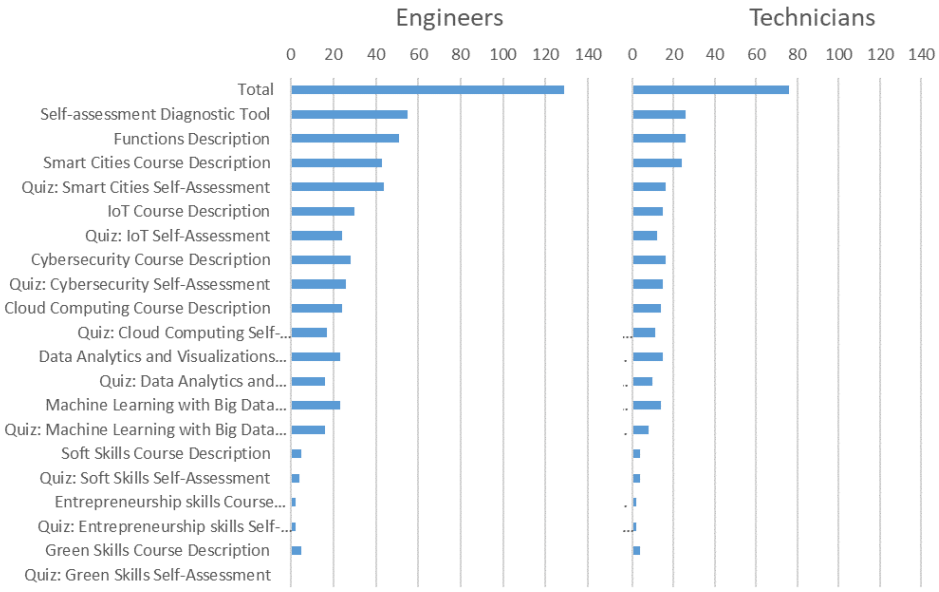

Figure 12 Data for usage of the diagnostic tool to identify individual needs and thus support personalized learning and training pathways, digital courses – number of users, October 2024 (teachers and test users excluded)

13.1.1 Smart Cities Engineers Diagnostic Tool Structure

The Diagnostic Tool for Engineers tool includes the following components:

1. **Forum Section**, including announcements and questions and answers
2. **Introduction**, including Self-assessment diagnostic tool functions description
3. Self-assessment **Modules for Specific Skills**:
   - ✓ **Smart Cities**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Internet of Things (IoT)**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Cybersecurity**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Cloud Computing**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Data Analytics and Visualization**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Machine Learning with Big Data**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **3D Printing**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Blockchain**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Drones**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Autonomous Vehicles**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Soft Skills**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Entrepreneurship Skills**: Interactive course description, accompanied by a self-diagnostic Quiz.
   - ✓ **Green Skills**: Interactive course description, accompanied by a self-diagnostic Quiz.

13.1.2 Smart Cities Technicians Diagnostic Tool Structure

The Smart Cities Technicians Diagnostic Tool is identical to the diagnostic tool for engineers as a structure but it includes content for technicians. The tool includes the following components:

1. **Forum Section**, including announcements and questions and answers
2. **Introduction**, including Self-assessment Diagnostic Tool functions Description
3. Self-assessment **Modules for Specific Skills**:

- ✓ **Smart Cities**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Internet of Things (IoT)**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Cybersecurity**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Cloud Computing**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Data Analytics and Visualization**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Machine Learning with Big Data**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **3D Printing**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Blockchain**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Drones**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Autonomous Vehicles**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Soft Skills**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Entrepreneurship Skills**: Interactive course description, accompanied by a self-diagnostic Quiz.
- ✓ **Green Skills**: Interactive course description, accompanied by a self-diagnostic Quiz.

13.2 Courses on digital skills

The courses on digital skills are designed in a book format for each module within Moodle, providing a well-structured and accessible learning experience. Each module consists of organized chapters and sub-chapters that guide learners through the content in a logical and progressive manner. This format ensures clarity and enables learners to navigate the material efficiently, whether they are engaging with text, multimedia resources, or interactive elements.

The content of these courses incorporates diverse educational materials, including instructional videos, interactive quizzes, practical exercises, and downloadable resources. This multimodal approach caters to different learning preferences and enhances the engagement of participants. Additionally, the courses integrate real-world case studies and scenarios, enabling learners to apply theoretical knowledge to practical situations relevant to the Smart Cities context.

To facilitate personalized learning, the platform tracks individual progress and provides feedback through automated quizzes, badges and certificates. Learners can revisit specific chapters or topics as needed, promoting mastery of the material at their own pace. The courses are also compatible with mobile devices, ensuring accessibility for learners anytime and anywhere.

Integrated discussion forums and messaging features within Moodle allow participants to collaborate, ask questions, and engage in peer-to-peer learning, further enriching the educational experience. This comprehensive approach ensures that learners not only acquire technical skills but also develop practical insights that are critical for addressing challenges in Smart Cities environments.

The Moodle platform ran smoothly during and after the pilots without any disruptions.

The usage of the different digital skills courses is provided in the Figures below:

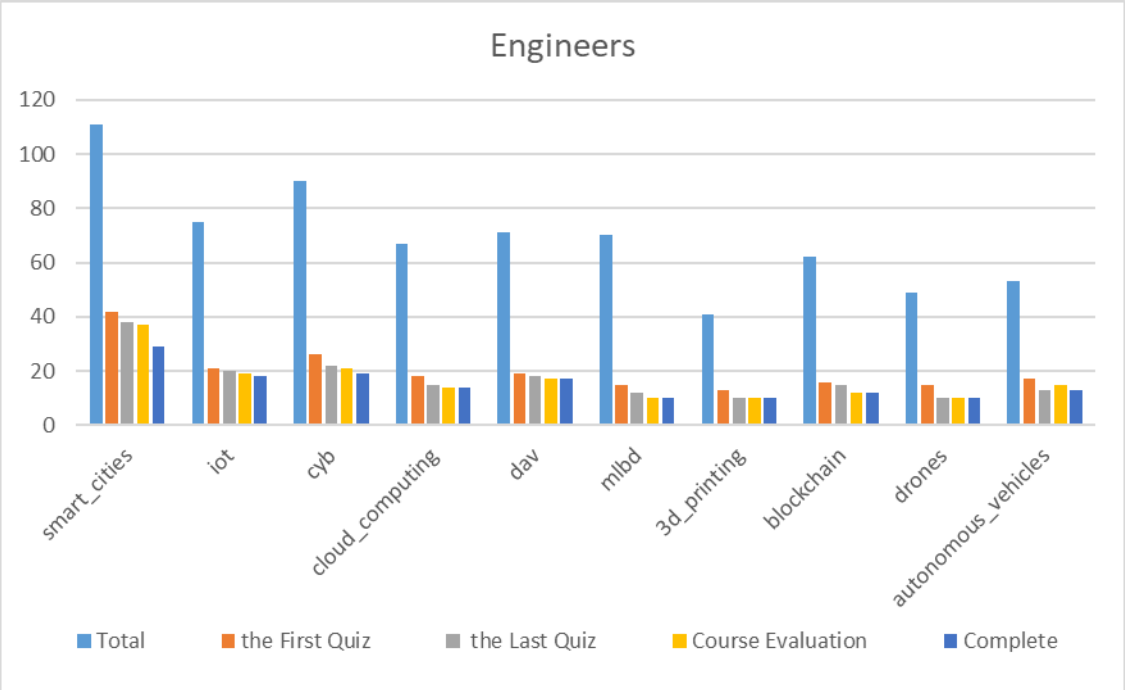

Figure 13 Data for usage of Technology-enhanced learning tools: Digital courses for engineers in MOOC– number of users, October 2024, (teachers and test users excluded)

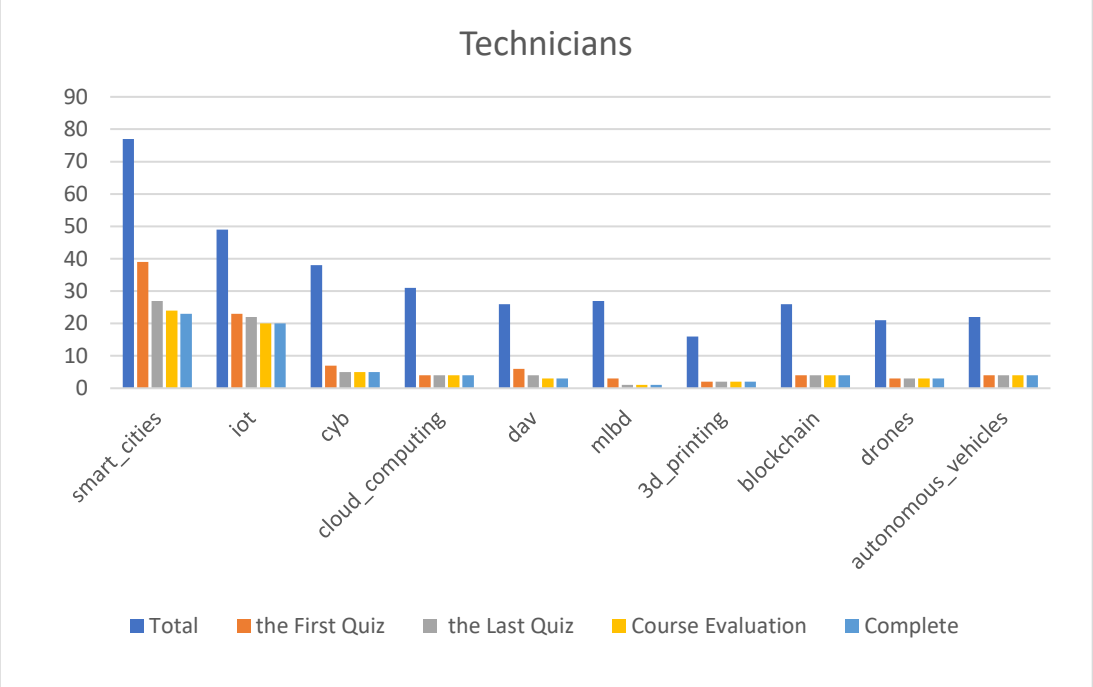

Figure 14 Data for usage of Technology-enhanced learning tools: Digital courses for technicians in MOOC– number of users, October 2024, (teachers and test users excluded)

13.2.1 Smart Cities for Engineers Course

The course is organized as follows:

1. **General Section**: Contains a forum and general course information.
2. **Module 1:** Introduction to the concept of Smart City, accompanied by a quiz.
3. **Module 2:** Cases of success, accompanied by a quiz.
4. **Module 3:** Technological solutions for Smart Cities, accompanied by a quiz.
5. **Module 4:** Planning and deployment of Smart Cities solutions**,** accompanied by a quiz.
6. **Course Assignment**: Focused on the Smart City Project for Engineers.
7. **Glossary**: Includes acronyms and definitions relevant to Smart Cities.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.

- Completing the course evaluation.
- Successfully completing the Smart City Project for Engineers.

Additionally, the course awards four badges, one for each module's quiz, to recognize participants' achievements throughout the program.

13.2.2 Internet of Things for Engineers

The Internet of Things for Engineers course is structured in a book format for each module within Moodle, offering a clear and comprehensive learning journey. The course consists of the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1:** Introduction to IoT, accompanied by Quiz 1.
3. **Module 2:** IoT Devices, accompanied by Quiz 2.
4. **Module 3:** IoT Communications, accompanied by Quiz 3.
5. **Module 4:** IoT Cloud, accompanied by Quiz 4.
6. **Course Assignment**: Focused on an IoT Project, requiring submission and grading.
7. **Glossary**: Includes acronyms and relevant terms for IoT.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all module quizzes.
    - Completing the course evaluation.
    - Successfully completing the IoT Project.

Additionally, the course awards four badges, one for the successful completion of each module's

13.2.3 Cybersecurity for Engineers Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction, covering topics such as Smart Cities and Industrial Control Systems, including the activity "Introduction to Smart Cities."

3. **Module 2**: Cyberthreats and Attacks, covering cybersecurity threats, attacks in Smart Cities, and social engineering, including the activity "Cyberthreats and Attacks."
4. **Module 3**: Cybersecurity Measures, addressing standards and policies, including the activity "Cybersecurity Measures."
5. **Module 4**: Cybersecurity Tools and Techniques, covering topics such as network segmentation, data protection, secure communications, and secure coding, with exercises on VPN communication, Modbus vulnerabilities, and SSL/TLS communications. Includes the activity "Cybersecurity Tools and Techniques."
6. **Module 5**: Monitoring Smart Cities, addressing anomaly detection, IDS/IPS, and SIEM tools, with an exercise on network traffic monitoring. Includes the activity "Monitoring Smart Cities."
7. **Module 6**: Risk Management, covering risk assessment and system recovery. Includes the activity "Risk Management."
8. **Course Assignment**: Focused on a Cybersecurity Project, requiring submission and grading.
9. **Glossary**: Provides a list of acronyms and relevant terms for cybersecurity.
10. **End of Course**: Includes the course evaluation.
11. **Certificate of Completion**: Awarded upon fulfilling the following requirements:
    - Completing required modules.
    - Achieving a passing score in all module activities.
    - Completing the course evaluation.
    - Successfully completing the Cybersecurity Project.

Additionally, the course awards six badges, one for each module's activity, to recognize and motivate participants throughout their learning experience.

13.2.4 Cloud Computing for Engineers Course

The course is composed of the following elements:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to Cloud Computing, accompanied by Quiz 1.
3. **Module 2**: Cloud Computing Infrastructure, accompanied by Quiz 2.
4. **Module 3**: Deployment of Cloud Computing Solutions, accompanied by Quiz 3.

5. **Module 4**: Hyperscalers: Amazon Web Services, Microsoft Azure, and Google Cloud Platform, accompanied by Quiz 4.
6. **Module 5**: Introduction to Software Development and Deployment for Cloud Computing, accompanied by Quiz 5.
7. **Module 6**: New Technologies Applied to Cloud Computing, accompanied by Quiz 6.
8. **Course Assignment**: Focused on the Cloud Computing Project for Engineers, requiring submission and grading.
9. **Glossary**: Provides a list of acronyms and terms relevant to cloud computing.
10. **End of Course**: Includes the course evaluation.
11. **Certificate of Completion**: Awarded upon fulfilling the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully completing the Cloud Computing Project for Engineers.

Additionally, the course awards six badges, one for each module's quiz, to recognize and motivate participants throughout their learning journey.

13.2.5 Data Analytics and Visualizations for Engineers Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to Data Analytics and Data Visualization, accompanied by Self-assessment 1.
3. **Module 2**: Data Analytics for Smart Cities, accompanied by Self-assessment 2.
4. **Module 3**: Data Visualization for Smart Cities, accompanied by Self-assessment 3.
5. **Module 4**: Smart Cities Use Cases, accompanied by Self-assessment 4.
6. **Course Assignment**: Focused on "Smart Cities Analytics – Harnessing Python for Data Insights and Visualization," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to data analytics and visualization.
8. **End of Course**: Includes the course evaluation.

9. **Certificate of Completion**: Awarded upon meeting the following requirements:
    - Completing required modules.
    - Achieving a passing score in all self-assessments.
    - Completing the course evaluation.
    - Successfully completing the Smart Cities Analytics assignment.

Additionally, the course awards four badges, one for successfully completing each self-assessment, to recognize participants' achievements throughout the program.

13.2.6 Machine Learning with Big Data for Engineers Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to Machine Learning and Big Data, covering foundational concepts and their application in Smart Cities. Includes Quiz 1.
3. **Module 2**: Machine Learning for Smart Cities, addressing data types, Python basics, ML frameworks, and techniques, including scenarios like classification, regression, and clustering. Includes Quiz 2.
4. **Module 3**: Machine Learning Case Studies for Smart Cities, providing Python-based hands-on examples, case study datasets, and implementation insights. Includes Quiz 3.
5. **Module 4**: Machine Learning, IoT, and Cloud Computing, exploring the integration of ML with IoT and cloud platforms, sensor data analysis, and time-series applications. Includes Quiz 4.
6. **Course Assignment**: Focused on leveraging Python libraries for data analytics and ML model building in the Smart Cities context. Students use provided datasets for their project submission and receive grading.
7. **Glossary**: Provides a list of acronyms and terms relevant to machine learning and big data.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following requirements:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.

- Successfully completing the Machine Learning and Big Data project.

Additionally, the course awards four badges, one for the successful completion of each module quiz, recognizing participants' progress and achievements.

13.2.7 3D Printing for Engineers Course

The course comprises the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to 3D Technologies, accompanied by Quiz 1.
3. **Module 2**: 3D Design, accompanied by Quiz 2.
4. **Module 3**: 3D Printing, accompanied by Quiz 3.
5. **Module 4**: Applications of 3D Printing in Smart Cities, accompanied by Quiz 4.
6. **Course Assignment**: Focused on a "3D Printing Project for Engineers," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to 3D printing and its applications.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following requirements:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully completing the 3D Printing project.

Additionally, the course awards four badges, one for the successful completion of each module quiz, to recognize and motivate participants' achievements throughout the program.

13.2.8 Blockchain for Engineers Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Blockchain Architecture, accompanied by Module 1 Quiz.
3. **Module 2**: Blockchain Technology, accompanied by Module 2 Quiz.
4. **Module 3**: Cryptography, accompanied by Module 3 Quiz..
5. **Module 4**: Data Structures in Blockchain, accompanied by Module 4 Quiz.

6. **Module 5**: Smart Contracts, accompanied by Module 5 Quiz.
7. **Module 6**: Web Development, accompanied by Module 6 Quiz.
8. **Module 7**: Programming for Blockchain, accompanied by Module 7 Quiz.
9. **Module 8**: Blockchain Applications for Smart Cities, accompanied by Module 8 Quiz.
10. **Course Assignment**: Focused on the "Blockchain Project for Engineers," requiring submission and grading.
11. **Glossary**: Provides a list of acronyms and terms relevant to blockchain technology.
12. **End of Course**: Includes the course evaluation.
13. **Certificate of Completion**: Awarded upon fulfilling the following requirements:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully completing the Blockchain project.

Additionally, the course awards eight badges, one for the successful completion of each module quiz, to recognise and motivate participants' achievements throughout the program.

13.2.9 Drones for Engineers Course

The course includes the following elements:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction, Historical Review, and Types of UAVs, accompanied by Quiz m1.
3. **Module 2**: Drone Technology, accompanied by Quiz m2.
4. **Module 3**: Drone Applications, accompanied by Quiz m3.
5. **Module 4**: Drone Applications in Smart Cities, accompanied by Quiz m4.
6. **Course Assignment**: Focused on the "SMACITE Drones Project for Engineers," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to drone technology and applications.

8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon fulfilling the following requirements:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully completing the Drones Project for Engineers.

Additionally, the course awards four badges, one for the successful completion of each module quiz, to recognize and motivate participants' progress throughout the program.

13.2.10 Autonomous Vehicles for Engineers Course

The course consists of the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction and Historical Review of Autonomous Cars, accompanied by Quiz m1.
3. **Module 2**: Technology of Autonomous Cars, accompanied by Quiz m2.
4. **Module 3**: Requirements of Autonomous Vehicles, accompanied by Quiz m3.
5. **Module 4**: Open Challenges, accompanied by Quiz m4.
6. **Course Assignment**: Focused on the "SMACITE Project: Autonomous Vehicles for Engineers," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to autonomous vehicles and their technologies.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully completing the Autonomous Vehicles Project.

Additionally, the course awards four badges, one for the successful completion of each module quiz, to recognize and encourage participants' progress throughout the program.

13.2.11 Smart Cities for Technicians Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to the Concept of Smart City, accompanied by Quiz 1.
3. **Module 2**: Cases of Success, accompanied by Quiz 2.
4. **Module 3**: Technological Solutions for Smart Cities, accompanied by Quiz 3.
5. **Course Assignment**: Focused on a "Smart City Project for Technicians," requiring submission and grading.
6. **Glossary**: Provides a list of acronyms relevant to Smart Cities.
7. **End of Course**: Includes the course evaluation.
8. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully submitting the Smart City Project.

Additionally, the course awards three badges, one for the successful completion of each module quiz, to recognize and motivate participants' achievements throughout the program.

13.2.12 Internet of Things for Technicians Course

The course includes the following elements:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to IoT, accompanied by Quiz 1.
3. **Module 2**: IoT Devices, accompanied by Quiz 2.
4. **Module 3**: IoT Communications, accompanied by Quiz 3.
5. **Course Assignment**: Focused on an "IoT Project," requiring submission and grading.
6. **Glossary**: Provides a list of acronyms relevant to IoT.
7. **End of Course**: Includes the course evaluation.
8. **Certificate of Completion**: Awarded upon meeting the following criteria:

- Completing required modules.
- Achieving a passing score in all quizzes.
- Completing the course evaluation.
- Successfully submitting the IoT Project.

Additionally, the course awards three badges, one for the successful completion of each module quiz, to recognize and motivate participants' progress.

13.2.13 Cybersecurity for Technicians Course

The course comprises the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Cyberthreats and Attacks, including topics such as cybersecurity threats and social engineering. Accompanied by the activity "Cyberthreats and Attacks."
3. **Module 2**: Cybersecurity Measures, covering standards and policies. Accompanied by the activity "Cybersecurity Measures."
4. **Module 3**: Cybersecurity Tools and Techniques, including network segmentation, data protection, and secure coding. Exercises include VPN communication, Modbus vulnerabilities, and SSL/TLS communications. Accompanied by the activity "Cybersecurity Tools and Techniques."
5. **Module 4**: Monitoring Smart Cities, covering anomaly detection and IDS/IPS tools. Includes an exercise on network traffic monitoring. Accompanied by the activity "Monitoring Smart Cities."
6. **Course Assignment**: Focused on a "Cybersecurity Project," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to cybersecurity.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all module activities.
    - Completing the course evaluation.
    - Successfully submitting the Cybersecurity Project.

Additionally, the course awards four badges, one for the successful completion of each module activity, to recognize and motivate participants' progress.

13.2.14 Cloud Computing for Technicians Course Report

The course comprises the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to Cloud Computing, accompanied by Quiz 1.
3. **Module 2**: Cloud Computing Infrastructure, accompanied by Quiz 2.
4. **Module 3**: Deployment of Cloud Computing Solutions, accompanied by Quiz 3.
5. **Module 4**: Hyperscalers:. Amazon Web Services, Microsoft Azure, and Google Cloud Platform, accompanied by Quiz 4.
6. **Course Assignment**: Focused on the "Cloud Computing Project for Technicians," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to cloud computing.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully submitting the Cloud Computing project.

Additionally, the course awards four badges, one for the successful completion of each module quiz, to recognize and motivate participants' achievements.

13.2.15 Data Analytics and Visualizations for Technicians Course

The course includes the following elements:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to Data Analytics and Data Visualization, accompanied by Self-assessment 1.
3. **Module 2**: Data Analytics for Smart Cities, accompanied by Self-assessment 2.
4. **Module 3**: Data Visualization for Smart Cities, accompanied by Self-assessment 3.
5. **Module 4**: Smart Cities Use Cases, accompanied by Self-assessment 4.

6. **Course Assignment**: Focused on "Smart Cities Analytics – Harnessing Python for Data Insights and Visualization," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to data analytics and visualization.
8. **End of Course**: Includes the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all self-assessments.
    - Completing the course evaluation.
    - Successfully submitting the Smart Cities Analytics assignment.

The course awards four badges, one for each self-assessment, to recognize participants' progress and achievements.

13.2.16 Machine Learning with Big Data for Technicians Course

The course includes the following:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to Machine Learning and Big Data, accompanied by Quiz 1.
3. **Module 2**: Machine Learning for Smart Cities, accompanied by Quiz 2.
4. **Module 3**: Machine Learning Case Studies for Smart Cities, providing hands-on examples, Python implementation, and datasets. Includes Quiz 3.
5. **Course Assignment**: Focused on leveraging Python libraries for data analytics and machine learning models in the context of Smart Cities. Includes datasets and templates for practical application.
6. **Glossary**: Provides a list of acronyms relevant to machine learning and big data.
7. **End of Course**: Includes the course evaluation.
8. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully submitting the Machine Learning project.

The course awards three badges, one for each module quiz, to motivate and recognize participants' achievements.

13.2.17 3D Printing for Technicians Course

The course consists of the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction to 3D Technologies, accompanied by Quiz 1.
3. **Module 2**: 3D Printing, accompanied by Quiz 2.
4. **Module 3**: Applications of 3D Printing in Smart Cities, covering slicers and their role in Smart Cities, accompanied by Quiz 3.
5. **Course Assignment**: Focused on a "3D Printing Project for Technicians," requiring submission and grading.
6. **Glossary**: Provides a list of acronyms relevant to 3D printing.
7. **End of Course**: Includes the course evaluation.
8. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully submitting the 3D Printing project.

Additionally, the course awards three badges, one for the successful completion of each module quiz, to recognize and motivate participants' achievements.

13.2.18 Blockchain for Technicians Course

The course includes the following elements:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Blockchain Architecture, accompanied by Module 1 Quiz.
3. **Module 2**: Blockchain Technology, accompanied by Module 2 Quiz.
4. **Module 3**: Cryptography, accompanied by Module 3 Quiz.
5. **Module 4**: Data Structures in Blockchain, accompanied by Module 4 Quiz.
6. **Module 5**: Smart Contracts, accompanied by Module 5 Quiz.
7. **Module 6**: Web Development, accompanied by Module 6 Quiz.

8. **Module 7**: Blockchain Applications for Smart Cities, accompanied by Module 7 Quiz.
9. **Course Assignment**: Focused on a "Blockchain Project for Technicians," requiring submission and grading.
10. **Glossary**: Provides a list of acronyms relevant to blockchain technology.
11. **End of Course**: Includes the course evaluation.
12. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all module quizzes.
    - Completing the course evaluation.
    - Successfully submitting the Blockchain project.

Additionally, the course awards seven badges, one for each module quiz, to encourage and recognize participants' progress.

13.2.19 Drones for Technicians Course

The course consists of the following:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction, Historical Review to Autonomus Cars, accompanied by Quiz m1.
3. **Module 2**: Drone Technology, accompanied by Quiz m2.
4. **Module 3**: Drone Applications, accompanied by Quiz m3.
5. **Module 4**: Drone Applications in Smart Cities, accompanied by Quiz m4.
6. **Course Assignment**: Focused on the "SMACITE Drones Project for Technicians," requiring submission and grading.
7. **Glossary**: Provides a list of acronyms relevant to drone technology.
8. **End of Course**: Includes additional learning resources such as documents, presentations, and the course evaluation.
9. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.

- Completing the course evaluation.
- Successfully submitting the Drones project.

The course awards four badges, one for the successful completion of each module quiz, to motivate participants' progress.

13.2.20 Autonomous Vehicles for Technicians Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information.
2. **Module 1**: Introduction and Historical Review of Autonomous Cars, accompanied by Quiz m1.
3. **Module 2**: Technology of Autonomous Cars, accompanied by Quiz m2.
4. **Course Assignment**: Focused on the "SMACITE Autonomous Vehicles Project for Technicians," requiring submission and grading.
5. **Glossary**: Provides a list of acronyms relevant to autonomous vehicle technology.
6. **End of Course**: Includes additional learning resources, documents, presentations, and the course evaluation. Includes additional learning resources such as documents, presentations, and the course evaluation.
7. **Certificate of Completion**: Awarded upon meeting the following criteria:
   - Completing required modules.
   - Achieving a passing score in all quizzes.
   - Completing the course evaluation.
   - Successfully submitting the Autonomous Vehicles project.

The course awards two badges, one for the successful completion of each module quiz, to encourage participants' progress.

13.3 Courses on horizontal skills

The horizontal skills courses were implemented in Moodle using an integrated approach that combined participation in the MOOC with immersive experiences in the Virtual World environment. This dual-format delivery ensured that learners gained both theoretical knowledge and practical application opportunities, enhancing their overall learning experience.

Within the Moodle platform, the horizontal skills courses were structured using an intuitive book format. Each module was divided into clearly defined chapters, featuring a mix of

text-based resources, instructional videos, and interactive quizzes. The MOOC provided foundational knowledge on critical horizontal skills such as leadership, teamwork, and problem-solving, while fostering self-paced learning and flexible access for participants.

To complement the MOOC experience, students engaged in collaborative exercises and scenario-based simulations within the Virtual World environment. This immersive platform, described in Deliverable D4.3: Virtual World for Smart Cities Training, offered a unique space where learners could practice and refine their soft, entrepreneurial, and green skills in a simulated Smart Cities context. The Virtual World facilitated experiential learning through realistic scenarios, role-playing activities, and teamwork challenges, enabling participants to apply theoretical concepts in a dynamic and interactive setting.

This blended learning approach, leveraging the strengths of both the MOOC and Virtual World, allowed learners to build their horizontal skills in a comprehensive manner. It not only improved their technical capabilities but also prepared them to navigate complex, real-world challenges with confidence and creativity.

The usage of the different horizontal skills courses is provided in the Figures below:

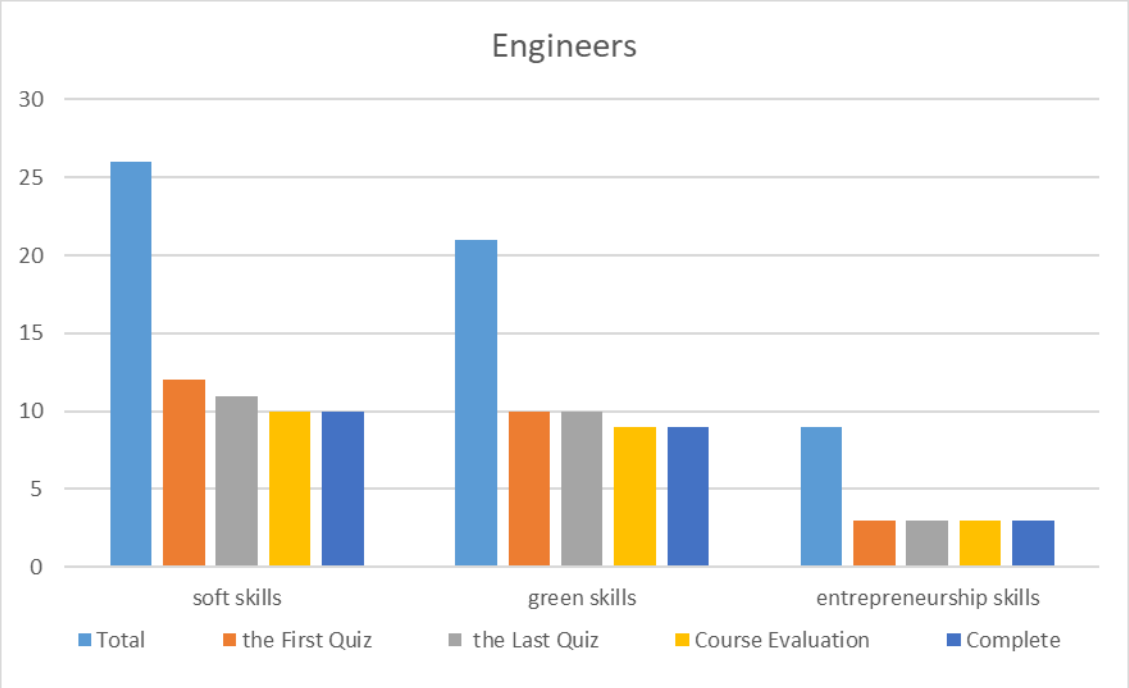

Figure 15 Data for usage of Technology-enhanced learning tools: Digital courses for engineers in MOOC– number of users, October 2024, (teachers and test users excluded)

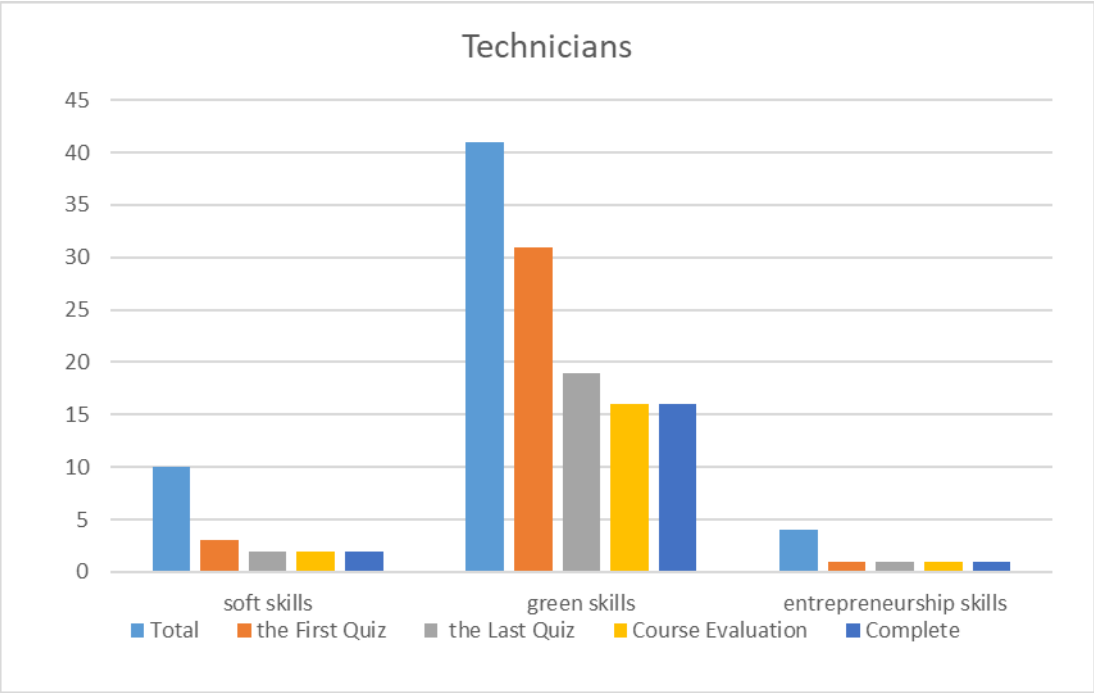

Figure 16 Data for usage of Technology-enhanced learning tools: Digital courses for technicians in MOOC– number of users, October 2024, (teachers and test users excluded)

13.3.1 Soft Skills for Engineers Course

The course includes the following components:

1. **General Section**: Contains a forum and general course information, along with enrollment options for training sessions in Virtual Worlds.
2. **Module 1**: Introduction to Soft Skills, accompanied by Quiz 1.
3. **Module 2**: Interpersonal Communication, covering key elements of communication, accompanied by Quiz 2.
4. **Module 3**: Teamwork and Collaboration, accompanied by Quiz 3.
5. **Module 4**: Critical Thinking and Problem Solving, accompanied by Quiz 4.
6. **Module 5**: Leadership and Management, accompanied by Quiz 5.
7. **Module 6**: Managing Through Change, focused on Change Management, accompanied by Quiz 6.
8. **Glossary**: Provides a list of acronyms relevant to soft skills and professional communication.
9. **End of Course**: Includes the course evaluation.

10. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully participating in Virtual Worlds training sessions.

Additionally, the course awards six badges, one for the successful completion of each module quiz, to recognize and motivate participants' progress throughout the program.

13.3.2 Entrepreneurship Skills for Engineers Course

The course includes the following elements:

1. **General Section**: Contains a forum, general course information, and enrollment options for online training sessions in Virtual Worlds.
2. **Module 1**: Introduction to Smart Cities and Entrepreneurship, accompanied by Quiz 1.
3. **Module 2**: Identifying Opportunities in Smart Cities, accompanied by Quiz 2.
4. **Module 3**: Developing Entrepreneurial Mindset and Skills, accompanied by Quiz 3.
5. **Module 4**: Technology Integration and Innovation, accompanied by Quiz 4.
6. **Module 5**: Funding, Growth, and Implementation, accompanied by Quiz 5.
7. **Module 6**: Practical Implementation and Action Planning - Business Plan, accompanied by Quiz 6.
8. **Module 7**: Interdisciplinary Collaboration, accompanied by Quiz 7.
9. **End of courrse** Includes the course evaluation.
10. **Glossary**: Provides a list of acronyms relevant to entrepreneurship and Smart Cities.
11. **End of Course**: Includes the course evaluation.
12. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully participating in Virtual Worlds training sessions.

Additionally, the course awards seven badges, one for the successful completion of each module quiz, to recognize and encourage participants' achievements throughout the program.

13.3.3 Green Skills for Engineers Course

The course includes the following components:

1. **General Section**: Contains a forum, general course information, and enrollment options for training sessions in Virtual Worlds.
2. **Module 1**: Apply the Circular Economy Concept, accompanied by a test.
3. **Module 2**: Energy Conservation, covering energy management planning in Smart Cities, accompanied by a test.
4. **Module 3**: Waste Management, accompanied by a test.
5. **Final Project (Optional)**: Students can work on a "Green Skills Project" during lessons in Virtual Worlds, using the provided template, though it is not mandatory for certification.
6. **Glossary**: Provides a list of acronyms relevant to green engineering and sustainability practices.
7. **End of Course**: Includes the course evaluation.
8. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all tests.
    - Completing the course evaluation.

Additionally, the course awards three badges, one for the successful completion of each module test, to recognize and motivate participants' achievements throughout the program.

13.3.4 Soft Skills for Technicians Course

The course comprises:

1. **General Section**: Contains a forum and general course information, along with Virtual Worlds training enrollment.
2. **Module 1**: Introduction to Soft Skills, accompanied by Quiz 1.
3. **Module 2**: Interpersonal Communication, accompanied by Quiz 2.

4. **Module 3**: Teamwork and Collaboration, accompanied by Quiz 3.
5. **Module 4**: Critical Thinking and Problem Solving, accompanied by Quiz 4.
6. **Module 5**: Leadership and Management, accompanied by Quiz 5.
7. **Module 6**: Managing Through Change, accompanied by Quiz 6.
8. **Glossary**: Provides a list of acronyms relevant to soft skills.
9. **End of Course**: Includes the course evaluation.
10. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully participating in Virtual Worlds training sessions.

The course awards six badges, one for the successful completion of each module quiz, to encourage participants' progress and achievements.

13.3.5 Entrepreneurship Skills for Technicians Course

The course consists of the following:

1. **General Section**: Contains a forum and general course information, with options for Virtual Worlds training enrollment.
2. **Module 1**: Introduction to Smart Cities and Entrepreneurship, accompanied by Quiz 1.
3. **Module 2**: Identifying Opportunities in Smart Cities, accompanied by Quiz 2.
4. **Module 3**: Developing Entrepreneurial Mindset and Skills, accompanied by Quiz 3.
5. **Module 4**: Technology Integration and Innovation, accompanied by Quiz 4.
6. **Module 5**: Funding, Growth, and Implementation, accompanied by Quiz 5.
7. **Module 6**: Practical Implementation and Action Planning - Business Plan, accompanied by Quiz 6.
8. **Module 7**: Interdisciplinary Collaboration, accompanied by Quiz 7.
9. **Glossary**: Provides a list of acronyms relevant to entrepreneurship.
10. **End of Course**: Includes the course evaluation.

11. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all quizzes.
    - Completing the course evaluation.
    - Successfully participating in Virtual Worlds training sessions.

The course awards seven badges, one for the successful completion of each module quiz, to recognize and motivate participants' achievements.

13.3.6 Green Skills for Technicians Course Report

The course includes the following components:

1. **General Section**: Contains a forum and general course information, along with enrollment options for Virtual Worlds training.
2. **Module 1**: Apply the Circular Economy Concept, accompanied by a test.
3. **Module 2**: Energy Conservation, accompanied by a test.
4. **Module 3**: Waste Management, accompanied by a test.
5. **Final Project (Optional)**: Focused on "Green Skills Project," allowing students to apply their knowledge during Virtual Worlds lessons (not required for certification).
6. **Glossary**: Provides a list of acronyms relevant to green skills and sustainability.
7. **End of Course**: Includes additional learning resources and the course evaluation.
8. **Certificate of Completion**: Awarded upon meeting the following criteria:
    - Completing required modules.
    - Achieving a passing score in all tests.
    - Completing the course evaluation.
    - Successfully participating in Virtual Worlds training sessions.

The course awards three badges, one for each module test, to encourage and recognize participants' achievements.

13.4 Teachers Support Course

13.4.1 Effectively Utilizing MOOC Resources: A Guide for Teachers

This “How to…” type of course is a short guide aiming to support teachers in creating and managing courses in SMACITE Moodle. The course was designed as a “live” document –

initially, the most basic features were presented, such as students' enrollment, tracking of students 'progress, and effectively communicating technical issues. After that, it has been continuously updated and expanded based on questions and requests received by the teachers themselves. The course was designed in a book format, which is easy to follow and use. It is based on official Moodle documentation. However, all the steps and hints provided in it were tested and adapted for the more recent version of the SMACITE Moodle.

The primary goal of this course was to provide teachers with the necessary skills to efficiently manage courses, create content, and handle student interactions. That's why it is internal for the project and it is accessible only to the MOOC teachers. The course includes the following components:

1. **Announcements**
2. **Introduction**
3. **Module 1:** How to Communicate Issues, Comments, Ideas, or Suggestions
4. **Module 2:** Content Creation
5. **Module 3:** Student Management
6. **Module 4:** Groups and Groupings

Since the course content is unavailable in other project deliverables, we attach it as an Annex 1 to this report.

14 Key Insights and Achievements from the MOOC Platform During the Pilot Phase

The ultimate goal of the SMACITE MOOC platform was to provide an opportunity for upskilling and reskilling of Smart Cities technicians and engineers through innovative, accessible, and high-quality online education. During the pilot phase, we validated the platform's design, functionality, and content delivery, validating its ability to address learner needs with helpful learning tools and personalized pathways.

We inspected the platform regarding its aimed role for empowering learners with both technical and non-technical skills and establishing a robust infrastructure for ongoing educational initiatives as well. We focused on ensuring the usability, technical stability of the SMACITE MOOC, as well as on its contribution to learner satisfaction, which was successfully achieved.

The platform demonstrated smooth operational performance throughout the pilot period. It efficiently proved technical demands, content management, and user interactions. This was a result of building a resilient infrastructure and thorough testing. Based on that the project team transitioned fully to the cloud-based platform, discontinuing on-premises backup systems. The cloud infrastructure provided enhanced scalability and operational efficiency, ensuring the availability of resources during peak usage and supporting sustained performance after the project ends, for a minimum of five years.

The team had agreed that the platform should be simple and functional in design, in order for it to be attractive for as many learners and educators as possible. We focused on an intuitive structure that's easy to navigate and easy for users to access course materials, assessments, and resources quickly. The diagnostic tool aimed to guide users in choosing tailored pathways taking into account their specific needs, thus making the whole experience even more personal.

During the pilot, the platform hosted and made accessible a vast range of courses addressing technical and non-technical skills critical for Smart Cities professionals. All courses shared the same modular structure, which made it possible to organize the content of the courses following the same logic. The courses include multimedia elements, quizzes, projects, and real-world case studies. Feedback from learners and teachers helped us to refine the courses and enhance their quality.

We supported educators in leading the courses and improving the content. We created a specialized course to guide teachers in using the platform effectively. It covered content creation, activity configuration, and student management. The project team provided prompt technical support through a centralized "helpdesk." In this way, we ensured timely

resolution of issues and helped teachers feel more confident in this role while using the platform.

Learners highly praised the platform, with courses receiving an average evaluation score of over 4 out of 5. Their feedback reflected the high-quality content and user-friendly presentation. Features such as badges and certificates were setup to motivate the learners and provide tangible recognition for their achievements. It was rewarding to observe how the platform was adequate in meeting educational needs and, at the same time, could provide an engaging experience.

We are confident that the SMACITE MOOC platform is well-positioned to support ongoing learning needs and foster innovation in Smart Cities education.

The platform's stable operation, user-friendly design, and engaging high-quality content are key achievements we would highlight.

Annex 1. How to use the MOOC resources for teachers? Course

Important note: *This chapter presents the content in MS Word format, serving as a textual foundation rather than a representation of the final visual layout. The graphical elements and visual design within the Moodle platform leverage the selected theme, ensuring they are both aesthetically appealing and optimized to enhance the learning experience*

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- 3.3. Import to Lessons or Books
- 3.4. Import to content block with the HTML editor in Moodle
- 3.5. Import a Docx file to Question bank
- 3.6. Simple import of questions to Question bank from a txt file
- 3.7. Adding Time Stamps in Videos
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5.5. Create Groupings (Optional)
5.6. Assign Groupings to Activities
5.7. Tips

1. Introduction

This is a short guide on creating and managing courses in SMACITE Moodle. It'll also help you learn how to effortlessly enroll students, track their progress, and effectively communicate technical issues.

This is a live document based on official Moodle documentation. It will be continuously updated and expanded based on questions and requests received. All the steps and hints provided here are tested and adapted for this much more recent version of the Moodle.

If you can't find the information you're looking for, please have a look here. Keep in mind that the content is tailored for Moodle version 3.11, so some menu locations may differ. However, it serves as an excellent starting point. Combine it with keyword searches, and you'll likely find what you need.

Alternatively, should you have any issues, comments, ideas, or suggestions, you can use the "support line" and submit a request through this form: https://forms.gle/pM2bVNWAPWU2wfHr6.

2. Module 1. How to communicate issuses, comments, ideas, or suggestions?

We've created a dedicated form as a "support line" for receiving and responding to your request related to Moodle https://forms.gle/pM2bVNWAPWU2wfHr6. Should you have any issues, comments, ideas, or suggestions, please send them through this form. Once your request is registered, you will receive confirmation and guidelines on maintaining your communication. The confirmation will be sent within 30 minutes to the email you submitted in the form.

3. Module 2. Content Creation

A course is an area where a teacher will add resources and activities for their students to complete. It might be a simple page with downloadable documents or it might be a complex set of tasks where learning progresses through interaction.

Courses may be created by admins, course creators or managers. Teachers can then add the content and re-organise them according to their own needs.

3.1. Prepare a MS Word file to Import into Moodle

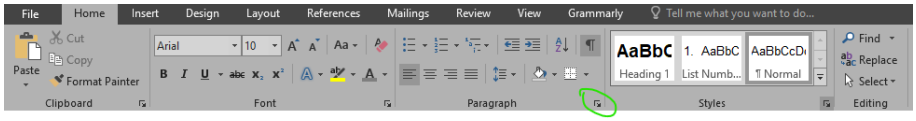
Generally, the Atto plugin should work with all Docx files. The Import does not work well with different styles and formats. Therefore, we recommend using minimum formatting options in a custom file specially created for Import and attached to this lesson.

Download the latest version of the file for Import from here. Please do not modify it in Google drive. Just Download it and work in another instance.

The formation is limited to four styles:

- Heading 1
- List Bullet
- List Number, and
- Normal

You can customize those styles by applying Bold, Italic, Superscript, Subscript, Colors, etc.; those formatting will be imported into the Page. To visualize the stiles as a separate menu, you should click on the Styles Ribbon



Then the styles menu would appear.

3.2. Create content in a file.

Use the “Normal” style as a starting point

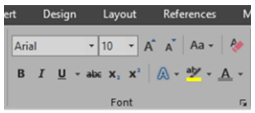
When you create content, it is essential to type or paste it in a Normal style and then format it. When you paste from another Word File, Webpage, or any other source, you need to use a paste special option, “Keep Text Only,“ or after the paste, you will need to select all newly pasted content and choose “Clear All” option from the Styles menu”. In this case, you will avoid applying hidden stiles and formatting. Such hidden formatting is not recognized and correctly imported by the plugin.

Heading 1 serves as a new lesson or chapter title

When you import a whole lesson or book from an MS Word file, the Heading 1 style serves as a content page or chapter separator and title. The plugin will create a webpage or chapter for each Heding 1 and copy the content below the Heading paragraph to the content page or chapter.

Text formats

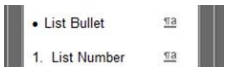
As already mentioned, you need to start with a clear Normal style. Then you can use the buttons on the top horizontal menu or extended font menu.



The plugin correctly recognizes **Bold**, *Italic*, ***Bold Italic***, Underline, Color, $_{\text{Subscript}}$, $^{\text{Superscript}}$, and ~~Strikethrough~~. It is possible to try other formats as well.

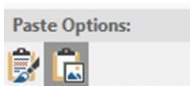
Bullets and numbering

The bullet and numbering buttons on the top horizontal menu are not imported correctly. Use “List Bullet” and “List Number” to format bullets and numbering. Be sure that you apply those styles to Normal style text.



Pictures

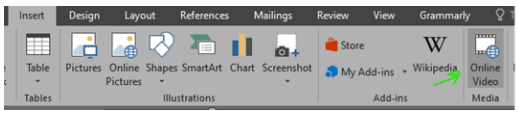
You can paste pictures, and they will be imported into Moodle. Please note to use the Picture Paste option.



If you create a hyperlink to the picture (Ctrl +K), it will also be available in Moodle. The picture should be in Normal paragraph style!

Video links

The first option is to insert a video through the Insert -> Online Video menu and point out the youtube clip you want to include.



In this case, you will see the video screen in the MS Word file and then in Moodle.

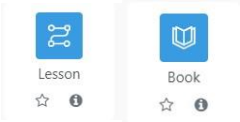
If you paste just a hyperlink to Video on YouTube, it will be visible as a hyperlink in the MS Word file, but when imported into Moodle, it will be displayed as an embedded screen.

3.3. Import to Lessons or Books

Once you prepare an MS Word file, you can import it as a lesson or as a book in Moodle as follows:

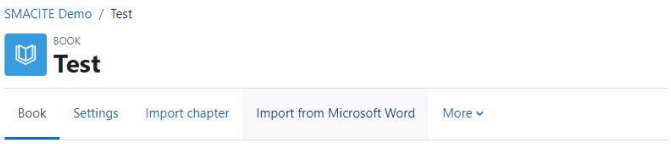
1. Click on add an activity or resource under the Topic to which you contribute.

2. Choose a lesson or book Icon



3. Fill out the properties of your lesson or book and click on the “Save and display” button at the end of the screen.

4. Click on the “Import from Microsoft Word” button and follow the instructions



3.4. Import to content block with the HTML editor in Moodle

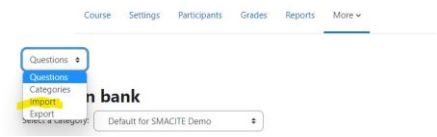
You can add content from MS Word Docx file to any content block with the HTML editor in Moodle by clicking on the (W) Word button as shown in the picture below

3.5. Import a Docx file to Question bank

Moodle allows the Import and Export of questions from and to MS Word Files. You can download a sample template for Multiple choice questions from here. To create a custom template, you must first create a question in Moodle, then export it to "Microsoft Word 2010 table format (wordtable)". You can add new questions in the template by copying and pasting existing ones.

1. Open Question bank from your course menu

2. Chose Import



3. Select "Microsoft Word 2010 table format (wordtable)" option and follow the instructions.

3.6. Simple import of questions to Question bank from a txt file

You can import single chouse questions directly from a txt file, as shown in the video below. Please note that the video was created from previous versions of Moodle and the buttons and menus are slightly different. You can see the menus in the previous chapter.

3.7. Adding Time Stamps in Videos

I. OWN videos

You can easily add timestamps/video chapters in the videos you upload/have already uploaded. You can do it manually, or automatically (and then adjust/change them if need be). You just need to be logged in the YouTube Studio. The full process is clearly described here: Make sure that:

- The first timestamp you list starts with 00:00.
- Your video has at least three timestamps listed in ascending order.
- The minimum length for video chapters is 10 seconds.

II. NOT own videos (manually)

1. Start the video. Stop it at the time you want a timestamp added.
2. Click the Share button. Check the Start at checkbox. Make sure the time is set correctly and adjust if need be. 3. Click Copy to copy the link.
4. Paste the link as and where you wish.

If you prepare your needed timings in advance, instead of going through the above process for every single timestamp, there is a quicker and easier way to prepare the timestamps :

1. Follow the 1-3 steps above to get the link with your first timestamp.
   Note: It's safer to obtain your fist link through the Share button than to copy and modify the url.
2. Paste the link in a document. It'd look like this https://www.youtube.com/live/Sx1RgCjmvfg?si=KmWv50adMW4q3OMi&t=140 , the '=140' meaning "start from the 140th second = at 2 min 20 sec".
   Note: If you open the link in a browser, within a few seconds, an 's' will be added to the url.
3. Replace the number at the end with the timing for any other timestamp you want to create. You can either put the equivalent in seconds, or follow the XhYmZs format. E.g. To link to 1:09:51, you can create 2 alternative links:
   a) https://www.youtube.com/live/Sx1RgCjmvfg?si=KmWv50adMW4q3OMi&t=1h9m51s
   b) https://www.youtube.com/live/Sx1RgCjmvfg?si=5jOYzAsftfkzsswq&t=4191
4. Now can then use the link as convenient for you. (e.g. 1:09:51 – Test) ***

Example

1. We take this video

https://www.youtube.com/live/Sx1RgCjmvfg?feature=shared (Come Away With Me

20th Anniversary Livestream)

2. We create our first timestamp at 0:01

https://www.youtube.com/live/Sx1RgCjmvfg?feature=shared&t=1.

3. Then I modify it:

https://www.youtube.com/live/Sx1RgCjmvfg?feature=shared&t=5m41s

https://www.youtube.com/live/Sx1RgCjmvfg?feature=shared&t=7m55s

https://www.youtube.com/live/Sx1RgCjmvfg?feature=shared&t=1h09m51s or https://www.youtube.com/live/Sx1RgCjmvfg? feature=shared&t=4191.

4. And we can prepare our TIMESTAMPS to be added to any description needed:

5:41 – Description 1

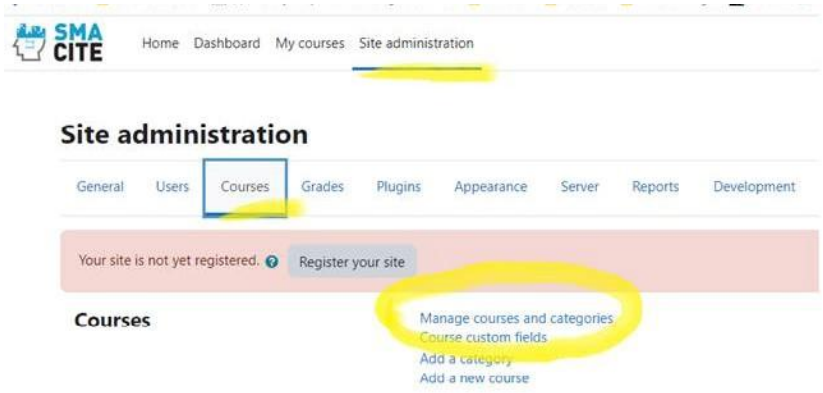
7:55 – Description 2

Etc.

3.8. Copy a course

If you need to clone a course, here is how to do it:

1. Finalize the content of the course you want to copy as much as possible.
2. From Site administration / Courses / Manage courses and categories.



3. Find the course you want to copy and click the Course Copy.

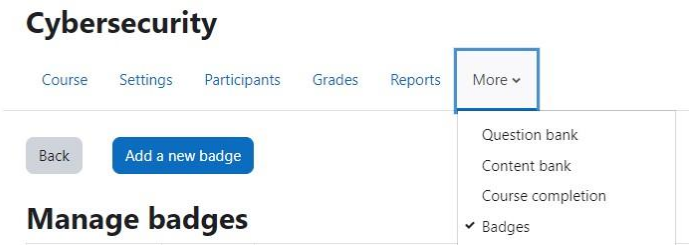
4. Set the course name and category. Save.
5. You can now access and edit the course as any other course.
6.

3.9. Edit and Enable Course Badges

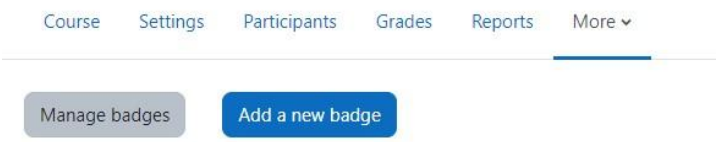
In the SMACITE project, students receive a digital badge for every completed module of the course.

The badge must only be enabled once all necessary settings have been added.

1. To edit a badge, go to your course, and from the *More* drop-down menu choose *Badges*:



2. Click on the *Manage badges* button to review and edit badges:



3. Clicking the name of an existing badge allows you to view its details and make changes *if it is not enabled* (the "eye" is closed - look in the Actions column)  .

If the status of the badge is AVAILABLE (the "eye" is open)  , this means that the badge criteria cannot be modifed. You need to disable access first.

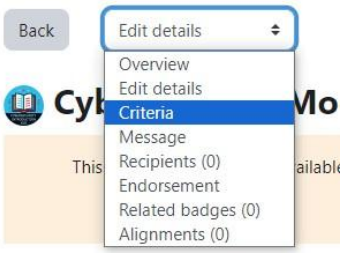
Note: Criteria can only be changed if the badge has never been issued before. Once a badge has been issued to at least one user, it automatically becomes **LOCKED**. If you need to modify details or criteria of a locked badge, you can duplicate this badge and make all the required changes.

4. Edit Details

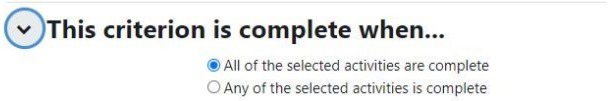
Go through the desciption section and edit it as you wish. Most of the rest is already done for you. However, if you want to modify anything else, you are welcome to do so.

5. Validate the criteria

Click the drop down/up arrows and choose *Criteria* from the list. Then click on the gear icon to modify anything if need be.



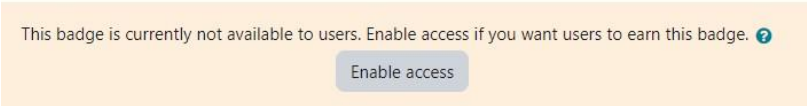
Note that following the SMACITE project policy, a badge is issued after completion of all the activities in a given module:



6. You could edit the message students receive when they are issued a badge, if you wish - click on *Message* in the list.

Note: Fields which are not completed (such as Endorsements, Related badges etc.) will not be shown on the badge page.

7. Once you are ready to enable access to the badge so that users can warn this badge, click on the "eye" to open it, or editing details form thegear icon, click on the *Enable access* button on the top:



Remember - If you need to modify details or criteria of a locked badge, you can duplicate this badge and make all the required changes.

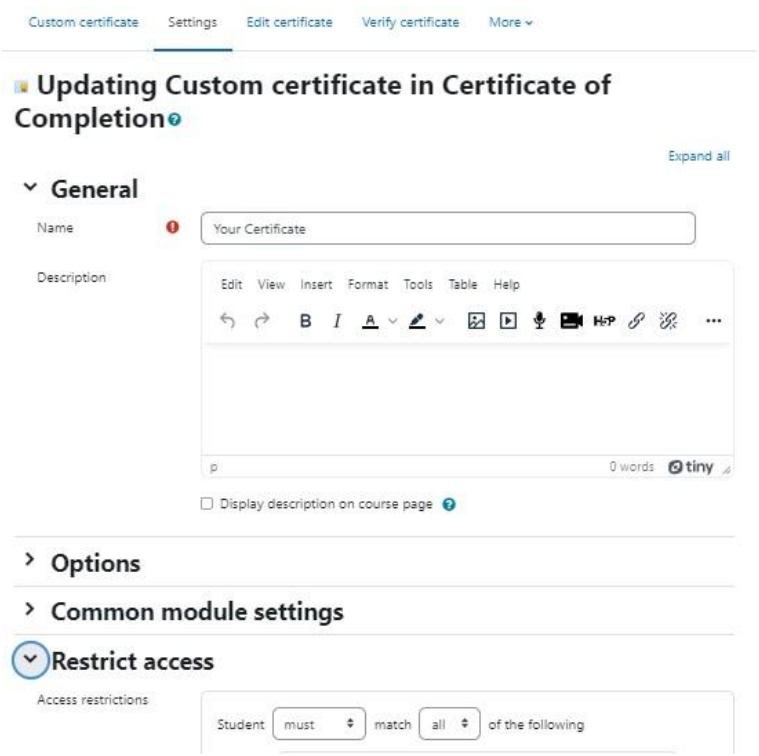
3.10. Edit Course Certificate of Attendance

In the SMACITE project, students receive a certification of attendance (in the form of micro-credentials) upon completion of the full course, provided that they have completed all the activities and have passed all the quizzes with 70% or more.

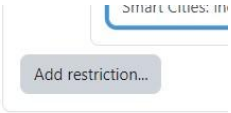
Certificates become accessible to users once all the criteria are fulfilled.

To review and edit the criteria, go Your certificate in the *Certificate of completion* module:

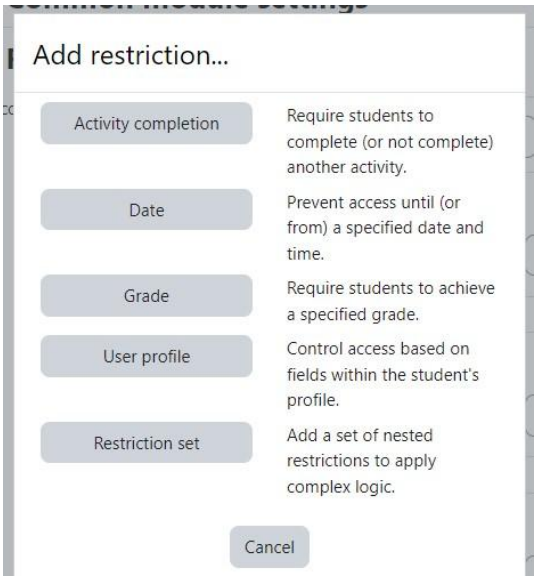
In the Settings tab, click on Restrict access:



When hitting the Add restriction button,



you can set the restrictions as needed:



For the entire SMACITE platform, it's been decided that in order to gain a certificate for attendance, a student must have:

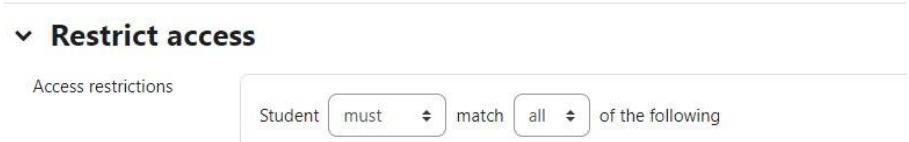
1. completed all lessons and exercises (i.e. all "books" that are part of the course must be marked Completed, and
2. achieved 70% or more for each quiz within the course

To set the first crerion, please press the Activity completion button from the Add restriction Menu. Then select an activity. Make sure that the mode next to it is set to "must be marked completed". Repeat for all relevant activities (books, exercises, etc).

To set the criterion about the quizzes, please press Grade from the Add restriction menu and proceed with the settings:

- from the dropdown list, select an Activity set the result required to be ≥70%
- Repeat for all relevant quizzes in the course.

Please make sure that the overall restriction (top) is set to: Student must match ALL of the following:



3.11. Assignment Activity

Adding an Assignment

1. In a course, with the editing turned on, choose 'Assignment' from the activity chooser. Create the assignment after the last module of the course.

2. Give it a name and, in the description explain what the students must submit. For example:

   "This project deals with the development of an IoT application using the wokwi online simulator. The deliverables you have to submit are (1) A report that describes the different steps you followed at wokwi to design the IoT application, including the selection of devices (e.g. sensors, microcontroller, single board computers) and the kind of connections between the devices; (2) The source code in .txt format of the IoT application; and (3) The downloaded project zip file". For more information see the project pdf file"

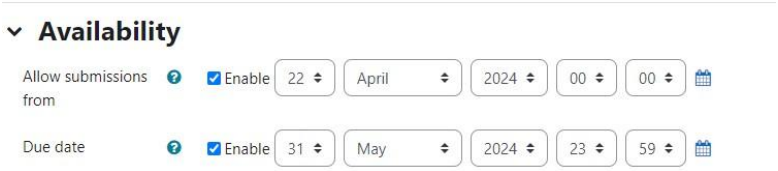
3. Expand and set the other relevant options:

Activity instructions (optional) - you can add what actions you would like students to complete for the assignement. You can also include relevant images, links, videos, etc. by clicking the appropriate icons. You can also upload additional support documents for students if needed.

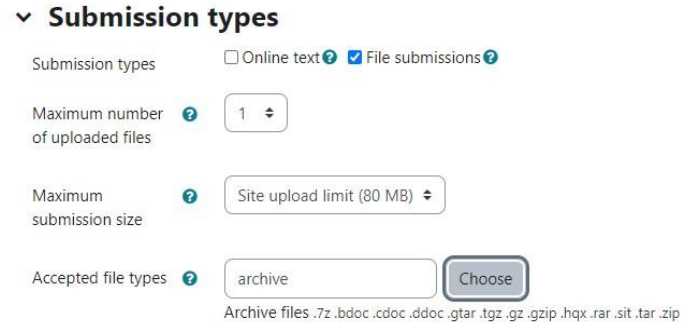
Only shown on hte submission page where students edit and submit their assignment.

Aditional files - upload the projec in pdf format.

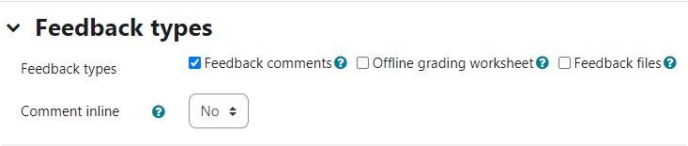
Availability - please set the *Allow submitions date* (the date the assignment is uploaded at the Moodle) and *Dute date* (31 May 2024).



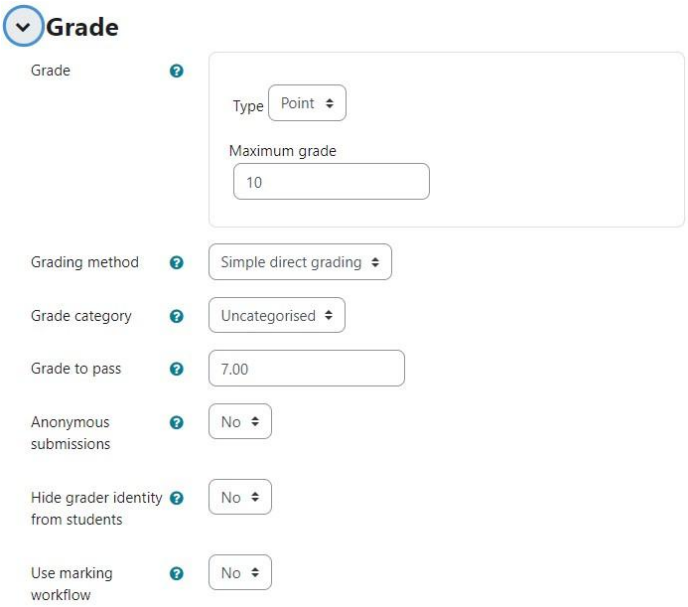
Submisison types - students are asked to submit 1 compressed file.



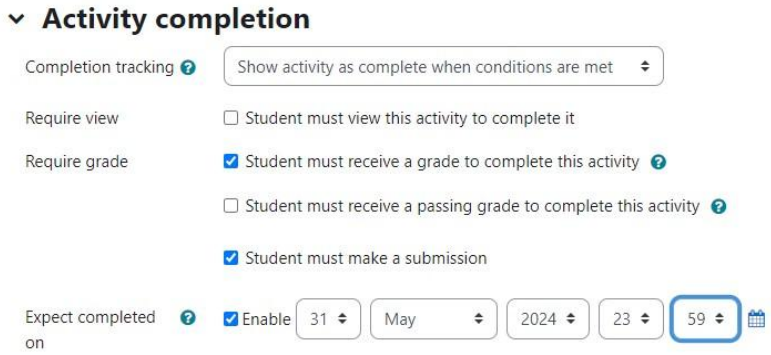
Feedback types - comments would be provided as feedback.



Grade - as in all quizzes, the pass grade is to be set to 7/10.



Activity completion - submission of an assignment will be one of the criteria for a student to achieve (or not) a certificate for completion of the course.

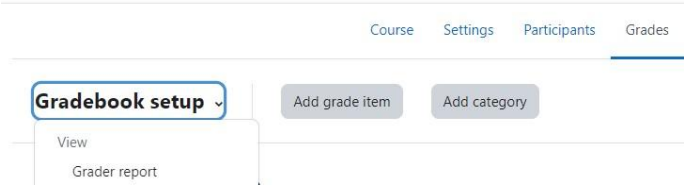


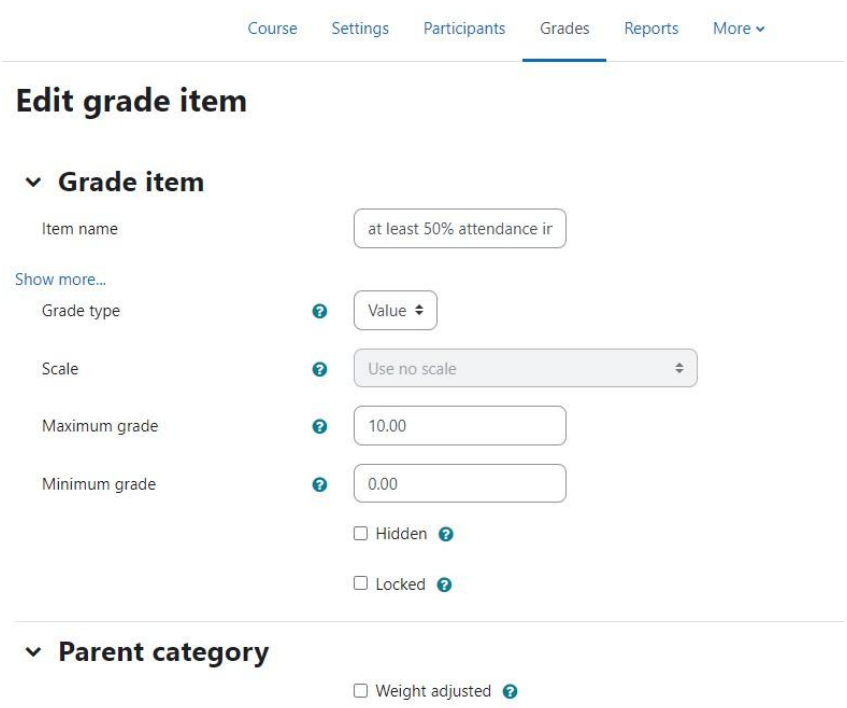
More information from the Moodle documentation (outlook may vary between one version of the Moodle and another but it still gives a good perspective):

- Using Assignment
- Assignment FAQ

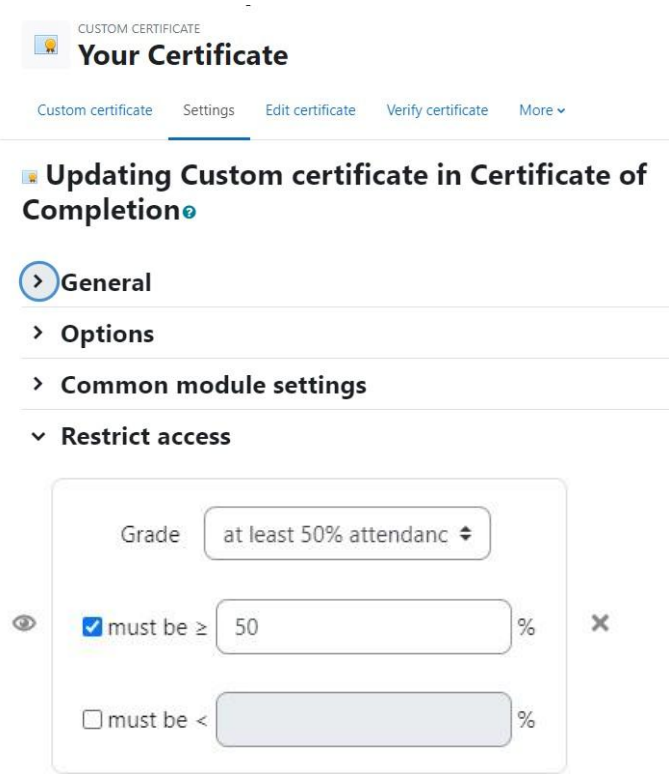
3.12. Configure live sessions attendance

To configure live sessions attendance, we first create a "grade item" from Grades/Gradebook Setup/Add grade item:





Then, we add the "at least 50% attendance " criterion to the certification of attendance criteria:



Finally, we make sure that the certificate topic is shown on the course page so that students can see it:

Teachers signify at least 50% attendance in the live sessions by accessing the gradebook and marking 10 for 100% of attendance, 5 for 50% of attendance etc.

Students will be issued a certificate of attendance in case they meet all the creteria, incl. at least 50% atteendance in the live sessions.

Since certificates are issued automatically, teachers (and MOOC managers) will only see those certificates that have already been issued by the system, i.e. that have been seen nad/or downloaded by the student.

4. Module 3. Students Management

As a teacher, you can perform various tasks to facilitate your course's administration and enhance the learning experience. Here are step-bystep instructions for some basic aspects of managing students in Moodle.

4.1. User Registration

In the SMACITE MOOC platform, an administrator can manually add accounts, or users can create their accounts themselves (e-mail-based selfregistration). When users want to register a new account, they need to hit the Create new account button on the Log-in page.

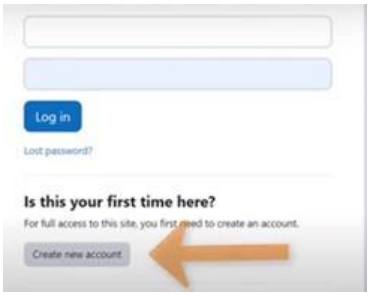


Figure 1: New account button

They will then receive an e-mail, which they must click on to confirm they want to access the SMACITE Moodle site.

Note: If they don't receive the email (due to it ending up in the spam folder, being refused by the remote server, an invalid email address entered, etc.), the administrator can manually confirm the account.

4.2. Course Enrollment

As a teacher, you can manage student enrollments efficiently using the platform's built-in tools. Below is a step-by-step guide to help you through the enrollment process.

Accessing Enrollment Options

1. Navigate to Your Course:

- Log in and select the course where you wish to manage enrollments.
- Ensure you have editing permissions.

2. Access the Enrollment Settings:

- In the course, click on the gear icon (top right corner).
- Select Participants from the dropdown menu.

Self-Enrollment Setup

1. Enable Self-Enrollment:

- Under the Participants page, click the Enrollment Methods link in the left-hand navigation bar.
- Click on Add method and select Self-enrollment.

2. Configure settings such as:

- Enrollment key (optional): Set a password to restrict access.
- Enrollment period: Define how long students can enroll.
- Maximum enrolled users: Set limits if needed.

2. Communicate the Details:

- Share the course link and enrollment key (if set) with your students.

Manual Enrollment

1. Add Students Manually:

- From the Participants page, click Enroll users (button on the top-right).
- Search for a user or select from the list.

- Assign a role (e.g., Student) and click Enroll.

2. Review Enrollments:

- Regularly review the list of participants to ensure accuracy.

Bulk Enrollment

1. Prepare a CSV File:

- Create a file with columns for username, email, course ID, and role.
- Save the file in .csv format.

2. Upload the File:

- Go to the Site Administration > Users > Upload Users.
- Follow the prompts to upload and assign users to the correct course.

Monitoring Enrollment

1. Track Enrollment Status:

- Use the Participants page to monitor active enrollments.
- Export participant lists if needed for records.

2. Adjust Enrollment Methods:

- Periodically review and update enrollment methods to maintain relevance and security.

4.3. Monitor Participants

Monitoring Enrollment

1. Track Enrollment Status:

- The block provides a visual indicator for students and teachers, showing the status of activities and course requirements.
- Export participant lists if needed for records.

2. Adjust Enrollment Methods:

- Periodically review and update enrollment methods to maintain relevance and security.

4.4. Tracking Progress

Moodle offers various tools for monitoring and assessing student progress. These tools enable teachers to identify students' learning patterns, provide targeted feedback, and ensure timely support.

Accessing Progress Tracking Tools

1. Course Completion Settings:

- Navigate to the course and click the gear icon.
- Select More... > Course completion.
- Configure criteria such as activity completion, grade requirements, or manual completion by a teacher.

2. Activity Completion:

- Enable activity completion tracking for specific activities during their setup:
    - In the activity settings, locate the Activity completion section.
    - Choose an appropriate completion condition (e.g., viewing, submission, passing grade).

Using the Course Completion Report

1. Access the Report:

- Navigate to the course page and click the gear icon.
- Select More... > Reports > Course completion.

2. Interpret the Report:

- The report displays completion statuses for each student against the criteria you set.
- Use filters to focus on specific groups or completion criteria.

Viewing the Activity Completion Report

1. Access the Report:

- On the course page, click on More... > Reports > Activity completion.
- This report provides an overview of which students have completed specific activities.

2. Customize the Report:

- Apply filters or sort data to identify patterns or gaps in engagement.

Using the Gradebook

1. Access the Gradebook:

    - In your course, click the gear icon and select Gradebook setup.

2. Track Grades:

    - View all graded activities and students' performance in one place.
    - Use categories to organize assessments for a clearer overview.

3. Export Data:

    - Export the gradebook in formats like CSV

or Excel for offline analysis. **Leveraging the**

Completion Progress Block

1. Add the Block:

    - Turn editing on in your course.
    - Add the Completion Progress block from the Add a block menu.

2. Track Progress:

    - The block provides a visual indicator for students and teachers, showing the status of activities and course requirements.
    - Students can see their individual progress, while teachers can view progress for the entire class.

Configuring Analytics Reports

1. Set Up Analytics:

    - Go to Site Administration> Analytics to enable analytics features.
    - Select predefined models, such as Students at risk of dropping out.

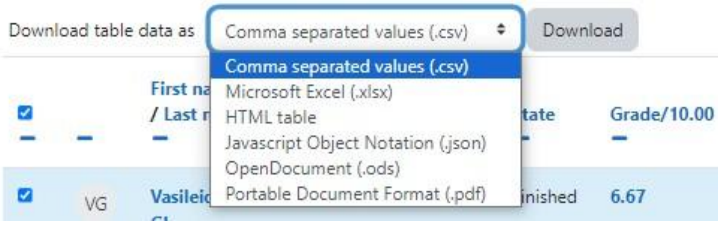
2. Generate Reports:

    - View insights under Reports > Analytics.
    - Use the data to identify students who may need additional support.

4.5. Quizzes - export of responses

In order to export students' responses, go to the Quiz and select the Results tab. Choose Responses.

Then adjust the settings as appropirate for you, check the responses you want to export, select the type of export the most convenient for you and hit Download.



4.6. Marking VW sessions attendance

To mark whether a student has/has not attended VW session, teachers need to manually put a "grade" in the gradebook (Grades/Grader report).

If the student has attended all of the VW sessions, the grade should be 10 (GS, ES) or 40 (SS). If s/he has attended half of the sessions (50%), the grade should be 5 (or 20 for the SS).

5. Module 4. Groups and Groupings

As a teacher or manager, you can organize several groups of students, each with a different teacher, to study a course simultaneously in Moodle; you can use the Group and Grouping features. These features allow you to manage access to course content, activities, and resources based on group membership. The chapter provides a step-by-step guide to setting this up.

5.1. Enable Group Mode at the Course Level

1. Navigate to your course.
2. Click on ‘Settings’ under the course administration menu. Look for the 'Groups' section.
3. Set the 'Group mode' to either 'Separate groups' (each group can only see their own group, others are invisible) or 'Visible groups' (each group works in their own group, but can also see other groups).
4. Enable the 'Force group mode' if you want to apply this setting to all activities in the course.
5. Save changes.

5.2. Create Groups

1. Go to the course administration menu and click on 'Participants'.
2. From the dropdown menu select > 'Groups'.
3. Click on 'Create group'.
4. Fill in the group name and description. Repeat this step for each group you need to create, corresponding to the student groups with different teachers.
5. Fill in an Enrolment key for the group.
   An enrolment key enables access to the course to be restricted to only those who know the key. If a group enrolment key is specified, then not only will entering that key let the user into the course, but it will also automatically make them a member of this group.
   Group enrollment keys must be enabled in the self-enrollment settings, and an enrollment key for the course must also be specified!
6. Select ‘Yes’ in the ‘Group Messaging’ field if you want to allow group members to send messages to each other via the messaging drawer.

5.3. Assign Members to Groups

1. Select a group from the list.
2. Click on 'Add/remove users' to assign students (and their respective teachers) to the group.
3. Use the search box to find users and add them to the group.

4. Repeat for each group.

5.4. Forums setting

1. In the Forum Page, select ‘More’, then 'Permissions'.
2. Find ‘Post to all groups you have access to’ add Student role through +. Be careful to add the role in the first column, ‘Roles with permission,’ but not in the second column, ‘Prohibited.’

- Forums can be set up for each group to facilitate communication between students and their respective teachers.

- Gradebook can be filtered by group to simplify teacher grading and feedback.

5.5. Create Groupings (Optional)

Groupings are collections of groups that can be used to manage access to course activities. They're useful if you have activities that should only be available to certain groups.

1. Go back to the 'Course ' page.
2. Click on the 'Groupings' from the drop-down menu.
3. Click on 'Create grouping'.
4. Give the grouping a name and description.
5. Click on 'Show groups in grouping'.
6. Select the groups you want to add to this grouping and click 'Add'.
7. Repeat for any other groupings you need.

5.6. Assign Groupings to Activities

For each activity or resource you want to restrict to a grouping:

1. Edit the settings of the activity/resource.
2. Find the 'Common module settings' section.
3. Set 'Group mode' to 'Separate groups' or 'Visible groups', as required.
4. Select the appropriate grouping from the 'Grouping' dropdown menu.
5. Save and return to the course.

5.7. Tips

- Regularly ensure all students and teachers are correctly assigned to their groups.
- Use Groupings wisely to manage access to activities and resources for specific groups.

Communicate the group arrangements clearly to all participants to avoid confusion.

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