

FOSTERING SUSTAINABILITY COMPETENCIES IN HIGHER EDUCATION: A MULTIMODAL APPROACH THROUGH TIME2ACT@SD MOOC

A. Loureiro¹, S. Leal¹, S. Oliveira², I. Messias¹, L. Barradas², A. Tekerek³, A. Güzel³, A. Piki⁴, C. Gonçalves⁵, J. Simons⁶, T. Mongelli⁷, V. Gelfgren⁸, X. Michiels⁶

¹*Santarém Polytechnic University and Life Quality Research Centre (PORTUGAL)*

²*Santarém Polytechnic University (PORTUGAL)*

³*Gazi University (TÜRKIYE)*

⁴*University of Central Lancashire Cyprus (CYPRUS)*

⁵*Rosto Solidário – Associação de Desenvolvimento Social e Humano (PORTUGAL)*

⁶*Thomas More (BELGIUM)*

⁷*Galileo.it (ITALY)*

⁸*Learnmera Oy (FINLAND)*

Abstract

The Time2Act@SDG Erasmus+ project aims to give higher education institutions the know-how and expertise they need to tackle the Sustainable Development Goals (SDGs) head on. The project offers three MOOC on the environment, the economy, and social issues. They provide a comprehensive approach to sustainability education that aligns with the principles of Education for Sustainable Development (ESD). The MOOC use new and creative ways to teach, including interactive content, digital tools, and hands-on learning. This helps students to think critically, solve problems, communicate, and work together. This paper looks at how the MOOC are designed and taught to see how they help students at HEIs to develop the skills they need to achieve the SDGs.

Keywords: Sustainable Development Goals (SDGs), MOOC, Higher Education, Education for Sustainable Development (ESD), Time2Act@SD.

1 INTRODUCTION

MOOC (Massive Open Online Courses) represent a disruptive innovation in the field of education, offering free and open access to high-quality content. It's [1] a novel paradigm in the domain of education, encompassing three key characteristics: connectivity, collaboration and personalisation of learning. These courses [2] are characterised by as shared curriculum and open learning outcomes and make effective use of social networks and OER (open educational resources). Facilitated by experts of recognised merit, they demonstrate enormous potential to democratise access to knowledge and promote lifelong learning. The MOOC is based on the active involvement of hundreds to thousands of learners who self-organise their participation according to learning objectives, previous knowledge and skills, and common interests.

MOOC have several advantages [3], being the provision of high-quality content a key benefit of these platforms. They often feature expert instructors and selected course materials, thereby offering access to high-quality educational content that would otherwise be inaccessible. The flexibility and convenience afforded by these learning resources is a significant benefit for adult learners or those with employment responsibilities, as it allows them to access course materials and complete assignments at a pace that suits them. The curriculum offers a diverse range of learning opportunities, encompassing a multitude of subjects, from scientific and academic disciplines to vocational skills. This enables learners to delve into areas of interest, thereby enhancing their knowledge and skills in a variety of domains. Interactive learning materials frequently incorporate interactive components, such as discussion forums, quizzes, and assignments, which can enhance active learning and learner engagement. One of the key advantages of online learning is its cost-effectiveness. In many cases, online courses are either free or significantly cheaper than traditional face-to-face courses, making education more accessible and affordable to a wider audience.

The 2030 Agenda for Sustainable Development stands as “a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom” [4]. The SDGs are a comprehensive and ambitious framework that aims to address a wide range of social, economic, and

environmental challenges facing the world today. This is to be achieved through the creation of engaging content, digital tools and innovative pedagogical approaches for use by HE (higher education) teachers [5]. To address the SDG, HEIs need to adopt teaching and learning approaches that are not usually the most common practice, namely interdisciplinary, action-based learning and the involvement of multiple actors [6]. In HEI, there are different ways in which we can educate for the SDG, such as: promoting innovative teaching methods, engaging in dialogue and collaboration that promotes critical thinking and problem-solving, using experiential learning, embedding the SDG in the curriculum, raising awareness, developing partnerships.

The Time2Act@SD Erasmus+ Project has the objective of contributing to the advancement of knowledge, abilities and dispositions, as well as modifying behaviours among students from European Union (EU) higher education institutions (HEI) in the domain of sustainable development (SD) and the Sustainable Development Goals (SDG).

In order to address the dearth of knowledge, skills, attitudes and actions pertaining to SD among young people enrolled in higher education (HE), and the absence of innovative educational resources to bridge this gap in students' education, the TIME2ACT@SD project aims to produce a set of open educational resources and to promote initiatives that meet these needs. The project employs innovative training and educational practices, including MOOC, webinars, gamification strategies, and experimental activities such as bootcamps, with the objective of enhancing the literacy of the target group in the field of SD/SDG. Additionally, it seeks to facilitate behavioural changes regarding individual preferences, awareness of SD, consumption habits, and lifestyles. These innovative practical short learning courses are designed to culminate in the conferral of micro-credentials upon students.

Innovative pedagogical practices may be defined as a novel or creative approach to teaching and learning, which is intended to enhance learners' performance, critical thinking, problem-solving abilities and overall learning outcomes. They entail the utilisation of innovative strategies, techniques and tools, which are supported by research and designed to align with the needs and interests of learners [7]. The adoption of interactive content, digital tools and innovative pedagogical approaches enables the achievement of the 4Cs, facilitating students' engagement in critical thinking, problem-solving, communication and collaborative work. The provision of workshops and boot camps facilitates the acquisition of knowledge through practical application, thereby effecting a change in behaviour. The MOOC will facilitate the acquisition of essential SDG competencies by students.

2 MOOC AS A PEDAGOGICAL APPROACH

MOOC frequently incorporate novel methodologies for the conveyance of knowledge and the facilitation of learner engagement with the material they provide (or could provide). Being viewed as capable of providing high quality education to anyone with internet access, its nature has the possibility of opening up education to the masses [8]. The key features of MOOC include online and multimedia learning, massive scale, flexibility and personalization, adaptive learning, assessment and feedback, and lifelong learning and professional development. Indeed, the efficacy of MOOC as a pedagogical practice may be contingent upon a number of factors, including the design of the course, the level of learner engagement, and the quality of teaching. However, one consequence of this flexible feature is that students attending MOOC have diversified learning styles and lifestyles, making it essential that the tools used in these types of courses are also diversified, as to be flexible enough to meet the needs and expectations of such diverse populations [8].

In the context of the recent pandemic, a significant number of educators have (re)turned to MOOC as a valuable learning resource. MOOC enhances the knowledge and competence of not only students, but also teachers and tutors, who may enroll in MOOC to augment their own knowledge and skills, which can then be integrated into their pedagogical practice.

The flexibility of MOOC with regard to time, space and rhythm allows students to learn at their own pace, with the option of either entering at an introductory level or progressing to more in-depth study, according to their existing knowledge and experience. Furthermore, MOOC relieves instructors of the burden of creating all the content required to cover the full scope of a curriculum unit. However, recent studies suggest that even if time flexibility is essential, frequent and sustained engagement from the student is also key for their success in completing MOOC [9] suggesting that self-paced human-led or algorithmic-led participation reminders may be the solution to help learners to engage more with their studies. This

makes time-flexibility a key characteristic, as well as a design that enables learners to engage with the MOOC for longer periods of time, even without time restrictions on the availability of the course.

MOOC can be employed in the classroom in a number of ways [3]. Primarily, they can be used as a supplementary learning resource, either as an additional material to be used alongside traditional classroom teaching or as a standalone resource for deeper exploration. It can be used in a flipped classroom model, where the content is learned outside of the classroom and the class time is dedicated to active learning activities such as discussions, group work and practical projects. Also, it can be used in a blended learning model, where the online component is provided so that students can learn at their own pace and the classroom time can be used for discussions, activities and individual support. Finally, it also allows the customisation of learning paths, which can be selected based on students' interests, needs and abilities. A study [10] suggests that hMOOC, or Hybrid-MOOC that can be integrated in hybrid learning environments, as they provide more interaction with the content and indicate that this type of MOOC can have a positive effect on knowledge sharing behaviour. This study also indicates that if learners enjoy hMOOC learning they will invest more time and energy in sharing and collecting information from it, providing effective engagement.

It is crucial to recognise that not all MOOC are appropriate for use in a traditional classroom setting. In addition to selecting appropriate MOOC, it is essential to develop strategies for integrating them into the classroom. It is therefore incumbent upon teachers to undertake a rigorous review, evaluation and assessment of the quality and effectiveness of the content to be introduced, ensuring that it is aligned with the learning objectives, teaching strategies and curriculum requirements. In the event that a MOOC is selected and integrated as a learning strategy, it is incumbent upon the teacher to monitor the progress of the pupils, provide support where necessary and allow time for discussion of the content in the classroom.

The project outcomes will be developed to increase the three levels of acquisition of sustainability competencies [11]: knowledge (conceptual learning), know-how (practical skills) and do (linked to the demonstration in action and its transferability to real-life situations). In the context of the Time2Act@SD Erasmus+ Project, we expect that MOOC will contribute to reaching the “knowledge” level of sustainable competencies amongst the HEI.

3 METHODOLOGY

In regard to the methodology employed in the development of the MOOC, this project adhered to the procedure outlined by the MIT Open Learning Initiative, which encompasses three phases [12]. The stages of preparation, planning and production were undertaken. Prior to the creation of MOOC content, it is essential to undertake a series of preliminary planning steps to ensure a comprehensive and effective process. To this end, a checklist based on previous studies' recommendations [13, 14] has been developed and used. It is of the utmost importance to ascertain the objective of the course and the intended audience, as well as to gain an understanding of the open education philosophy that underpins a MOOC.

A timeline should be created with detailed tasks, and a plan should be made for communications, including the marketing of the course to potential enrollees, the management of regular emails to enrolled students, and the utilisation of social networking. It is essential to identify the objectives for offering the course, including determining the optimal time frame for the course and conceptualising a course design (such as open, structured, or non-linear) and release format (for example, releasing all the content at launch or releasing it on a week-by-week basis).

It is essential to define the overarching learning outcomes, along with the criteria for assessment and the level of achievement that will be deemed acceptable for conferring a course completion certificate. It is advisable to conduct a thorough assessment of the required and available resources, including technologies, general staffing, and specialised human resources needs, as well as space requirements (such as those for filming). Additionally, it is crucial to determine the type of assessments and feedback desired for students during the course, as well as the archiving and repackaging plans for the course materials following the initial deployment.

Furthermore, comprehensive plans should be established for both faculty and staff development, as well as for addressing the potential needs of enrolled students, including strategies for managing disruptions or challenges.

To guarantee meticulous instructional design and superior quality courses, this project has employed the ADDIE model, comprising the phases of Analysis, Design, Development, Implementation and Evaluation. In this particular model, analysis is the input to the system; design, development and evaluation are the process; and implementation is the result. These elements overlap somewhat, depending on the project, and as the system is dynamic, there will be some sharing of tasks [15]. This model has demonstrated efficacy over time and has proven adaptable to diverse pedagogical contexts. The model's primary function is to facilitate the development of courses, offering a flexible and pragmatic structure. Although the model is represented graphically as a linear sequence, it can be applied in an iterative and non-linear manner, particularly when existing resources are used.

In order to guarantee uniformity in the structure and visual aesthetic of each MOOC, a mockup was conceptualised, produced and made accessible to the partners' team. Therefore, each course, developed by each partner, followed the mockup as a reference. The objective was to create courses that were sufficiently attractive, comprehensive in content, comprised a variety of materials, brief in duration, and allow participation at everyone's own pace.

The MOOC's contents were developed on the basis of the findings of a survey conducted among HE students and teachers with the objective of gauging their familiarity with the concept of sustainability and their ability to apply the SDG in practice.

4 RESULTS

The three MOOC (Environmental Sustainability; Social Sustainability; Economic Sustainability) are available at the Time2Act@SD platform, based on a Moodle instalment, developed in English and translated in the different languages of the project's partners (Dutch, Greek, Italian, Portuguese, Turkish).

The structure of each MOOC is analogous, comprising three modules plus Introduction to the topic. Each module features video presentations that align with the MOOC's overarching theme. Additionally, it incorporates interactive exercises that utilize H5P technology, facilitating deeper knowledge acquisition. A final assessment is also included, enabling learners to gauge their comprehension and knowledge retention.

The MOOC will enable the achievement of the SDG target 4.7: "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development" [16]. Ultimately, the aim is to prepare students to play their part effectively by translating this knowledge and skills into pro-SD attitudes and behaviors.

The use of platforms based on Moodle technology allows the creation of training courses, the evaluation of acquired knowledge and the provision of a badge that certifies the training and acquired knowledge. Upon the successful completion of each course, participants are awarded certification in the form of an open badge, which can be added to digital portfolios. Additionally, badges are easily shared on the web and via social media, allowing participants to showcase their accomplishments, acting as a motivational device.

Despite the completion of the course development and deposition on the platform, the courses have not yet been made available to the European higher education community. It is anticipated that they will be accessible for participation during the current academic year.

Moreover, the goal is to provide the MOOC on additional platforms on a more extensive scale, thereby reaching a broader audience. This objective will be attained by offering the MOOC on open access at the NAU platform (<https://www.nau.edu.pt/pt/>) and the European School Education Platform, thereby enabling higher education (HE) teachers to utilize them throughout the project's implementation and beyond its conclusion.

The three MOOC can be found on the Time2Act@SD platform available at the following URL: <https://mooc-time2act.ipsantarem.pt/> (cf. Figure 1).

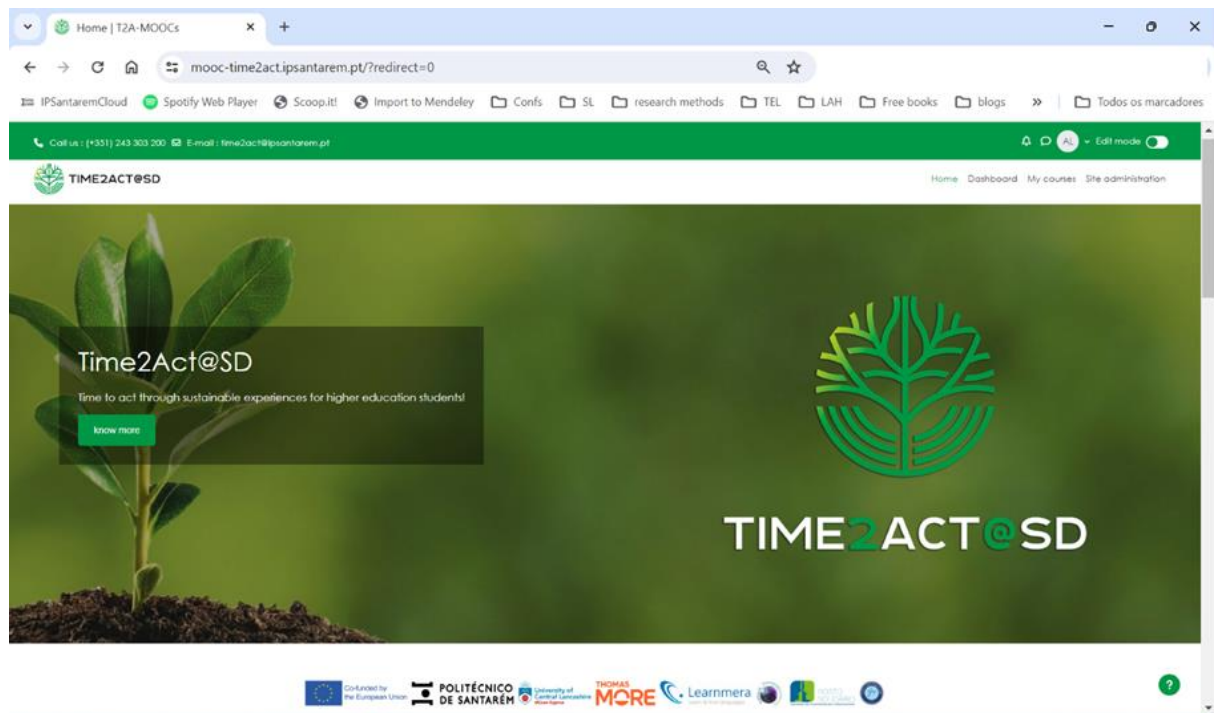


Figure 1 – Time2Act@SD MOOC platform

5 CONCLUSIONS

The Time2Act@SD Erasmus+ project demonstrates MOOC' potential as an effective instructional tool for advancing sustainability capabilities in higher education. By incorporating novel pedagogical methods such as interactive content, personalized learning paths, and multimodal resources, the initiative equips students and educators with the skills they need to engage deeply with SDGs. The adoption of the ADDIE paradigm in the development of these MOOC ensures a systematic, adaptive, and high-quality learning experience that can be continuously adjusted in response to student input and institutional requirements.

The project's main contribution is the democratization of access to sustainability education. The use of open-access MOOC facilitates the transcending of geographical and economic boundaries, therefore facilitating the distribution of sustainability information and capabilities.

The courses' bilingual and adaptable design enhances their accessibility, allowing learners from varied cultural and academic backgrounds to benefit from the content. Furthermore, the project tackles the important requirement for lifelong learning considering rapid global change. The implementation of digital badges and certifications provides learners with a tangible form of recognition for their accomplishments, which can improve their employability and academic credentials. This not only provides participants with the motivation to complete the courses, but it also encourages them to continue developing their sustainability competencies beyond the conclusion of the MOOC.

Furthermore, incorporating MOOC into higher education courses offers a great resource for instructors, as it provides a flexible and scalable method of incorporating SDG-related content into their teaching.

MOOC's numerous pedagogical uses, such as use in flipped classrooms or blended learning environments, enable institutions to tailor the courses to their specific needs and educational goals. Time2Act@SD's provision of these innovative tools to educators also helps teachers and academic staff improve professionally, establishing a culture of sustainability inside institutions.

In the future, the scalability of the project's platform, as well as the intention to expand the MOOC to new educational platforms like as NAU and the European School Education Platform, have the potential to dramatically improve the reach and effect of these courses. By broadening its reach, Time2Act@SD is poised to become a major effort in the promotion of sustainable development education across Europe.

In conclusion, the Time2Act@SD initiative exemplifies MOOC's ability to share knowledge while also cultivating the crucial skills and competencies required to address the pressing global concerns

contained in the SDGs. This project adds to higher education institutions' greater aim of preparing students and instructors to actively participate in developing a sustainable future by creating a holistic, accessible, and innovative learning environment. As the need for sustainability education develops, initiatives like Time2Act@SD will play a critical role in developing the next generation of leaders and changemakers capable of addressing today's difficult challenges.

ACKNOWLEDGEMENTS

This work was supported by the European Union Erasmus+ programme (grant number 2022-1-PT01-KA220-HED-000087984); and the Life Quality Research Centre by Fundação para a Ciência e Tecnologia (grant number UID/CED/04748/2020).

REFERENCES

- [1] G. Siemens. "Connectivism: A learning theory for the digital age". *International Journal of Instructional Technology and Distance Learning*, 2005. Retrieved from https://www.itdl.org/Journal/Jan_05/article01.htm
- [2] A. McAuley, B. Stewart, G. Siemens, D. Cormier. *The MOOC model for digital practice*. University of Prince Edward Island, 2010.
- [3] A. Loureiro. "Bringing the MOOC into the classroom: an innovative pedagogical practice at the Polytechnic Institute of Santarém". *PROF XXI Global Symposium MOOC Lx23, LE@D - Universidade Aberta*, 2023. Retrieved from <http://hdl.handle.net/10400.15/4499>
- [4] United Nations. Resolution adopted by the General Assembly on 25 September 2015. *Transforming our world: the 2030 Agenda for Sustainable Development*. 2015. Retrieved from <https://documents.un.org/doc/undoc/gen/n15/291/89/pdf/n1529189.pdf>
- [5] Polytechnic Institute of Santarém. *TIME2ACT@SD*, 2024. Retrieved from <https://time2act.ipsantarem.pt/>
- [6] Sustainable Development Solutions Network. *Accelerating Education for the SDGs in Universities*, 2020. Retrieved from https://irp-cdn.multiscreensite.com/be6d1d56/files/uploaded/accelerating-education-for-the-sdgs-in-unis-web_zZuYLaoZRHK1L77zAd4n.pdf
- [7] M. Yusuf, M. Mai, S. Maki, K. Shaffeei, A. Folashade, B. Babatunde, M. Shittu. "A Systematic Review of Pedagogical Practices in the Education 4.0", *Hong Kong Journal of Social Sciences*. No. 60 Autumn/Winter 2022. Retrieved from <https://doi.org/10.55463/hkjss.issn.1021-3619.60.49>
- [8] I. Nawrot, A. Doucet. "Building engagement for MOOC students: introducing support for time management on online learning platforms". *Proceedings of the 23rd International Conference on World Wide Web (WWW '14 Companion)*. Association for Computing Machinery, 2014. <https://doi.org/10.1145/2567948.2580054>
- [9] G. Veletsianos, R. Kimmons, R. Larsen, J. Rogers. "Temporal flexibility, gender, and online learning completion". *Distance Education*, 42(1), 22–36, 2021. <https://doi.org/10.1080/01587919.2020.1869523>
- [10] Y.Q. Zhang, A. Mangmeechai. "Exploring the factors of undergraduate learners' engagement and knowledge sharing for sustainable hMOOC learning". *International Journal of Sustainable Development and Planning*, Vol. 17, No. 3, pp. 1007-1015, 2022. <https://doi.org/10.18280/ijstdp.170332>
- [11] G. Cebrián, D. Pascual, Á. Moraleda. "Perception of sustainability competencies amongst Spanish pre-service secondary school teachers". *International Journal of Sustainability in Higher Education*, 20(7), 1171–1190, 2019. Retrieved from <https://doi.org/10.1108/IJSHE-10-2018-0168>
- [12] MIT Open Learning. *Building a MOOC*. Accessed 19 september, 2024. Retrieved from <https://openlearning.mit.edu/building-mooc>
- [13] A. M. F. Yousef, M. A. Chatti, U. Schroeder, M. Wosnitza. "What drives a successful MOOC? An empirical examination of criteria to assure design quality of MOOCs". *Proceedings - IEEE*

14th International Conference on Advanced Learning Technologies, ICALT 2014, 44-48.
Retrieved from <https://doi.org/10.1109/ICALT.2014.23>

- [14] D. Demaree, A. Kruse, S. Pennestri, J. Russell, T. Schlafly, Y. Vovides. "From Planning to Launching MOOCs: Guidelines and Tips from GeorgetownX". *E-Learning, E-Education, and Online Training. eLEOT 2014. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, vol 138*. Springer, Cham. Retrieved from https://doi.org/10.1007/978-3-319-13293-8_9
- [15] Hodell, C. *ISD From The Ground Up, 4th Edition*. Association for Talent Development. 2015. ISBN: 9781607281665
- [16] UNESCO. *Education 2030: Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000245656.locale=en>