

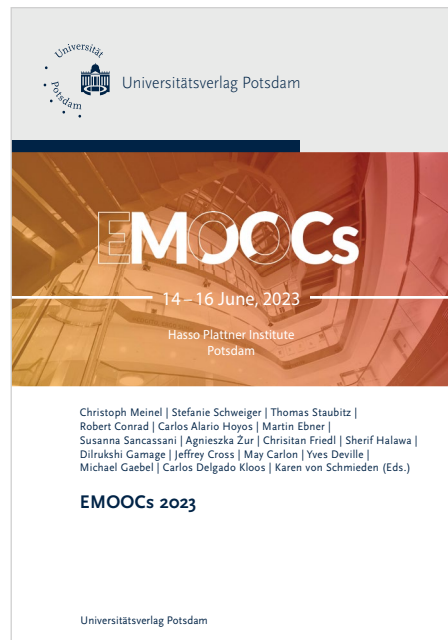
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How to Reuse Inclusive Stem Moocs in Blended Settings to Engage Young Girls to Scientific Careers

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The FOSTWOM project (2019–2022), an ERASMUS+ funding, gave METID (Politecnico di Milano) and the MOOC Técnico (Instituto Superior Técnico, University of Lisbon), together with other partners, the opportunity to support the design and creation of gender-inclusive MOOCs. Among other project outputs, we designed a toolkit and a framework that enabled the production of two MOOCs for undergraduate and graduate students in Science, Technology, Engineering and Maths (STEM) and used them as academic content free of gender stereotypes about intellectual ability. In this short paper, the authors aim to 1) briefly share the main outputs of the project; 2) tell the story of how the FOSTWOM approach together with 3) a motivational strategy, the Heroine’s Learning Journey, proved to be effective in the context of rural and marginal areas in Brazil, with young girls as a specific target audience.

1 Introduction

METID, the learning innovation Unit of Politecnico di Milano, and MOOC Técnico from Instituto Superior Técnico of the University of Lisbon, together with other partners, had the opportunity to develop a toolkit and a framework to support the creation of gender-inclusive STEM (Science, Technology, Engineering and Maths) MOOCs. As a result of an ERASMUS+ funding opportunity, the FOSTWOM project⁴ produced firstly the toolkit and a MOOC for educators that explained this framework, and then two MOOCs free of gender stereotypes about intellectual ability aimed to undergraduate and graduate students in STEM. The inclusive

⁴<https://fostwom.eu/>

potential of MOOCs has proved to be effective in more than one context so far and our experiment re-enforces that fact.

The FOSTWOM project's team developed a toolkit⁵ open to MOOCs stakeholders, content experts, instructional and graphic designers, that can guide them to create more inclusive STEM MOOCs. Then, based on the toolkit guidelines, the "Machine Learning, Maths & Ethics: Hands-on" online course was developed, using gender-conscious perspective in narratives, in the video and text language, in the use of images, and in the interviews. Parallel to this, two of the authors developed a motivational strategy for following STEM MOOCs, the Heroine's Learning Journey (HLJ)⁶. Acting as a path to follow the MOOC, the HLJ functioned as a motivational narrative metaphor for the internal challenges of (female) STEM students, trying to overcome their own fears and challenges in the STEM field. Thus, after translating all content into Portuguese, a second edition of the MOOC "Machine Learning, Maths & Ethics: Hands-on" with the HLJ embedded was put in place. This edition of the STEM MOOC proved to be effective, particularly, in the context of rural and marginal areas in Brazil, with young girls as a specific target audience.

A high-school teacher from the city of Recreio-Minas Gerais, Brazil, supported the FOSTWOM MOOCs initiative and facilitated the use of the school computer lab so that students could take the online course using the lab computers. In addition, to help overcome the technical difficulties posed by the subject of the MOOC itself, namely, machine learning algorithms and maths, a young researcher from the Federal University of Rio de Janeiro, Brazil, provided online individualised support to the participants from Recreio.

In section 2 of this short paper, the authors aim to briefly share the main outputs of the project itself and in section 3, to report the experiment of how the FOSTWOM approach together with the motivational strategy of the HLJ proved to be effective for young girls from rural and marginal areas in Brazil. By efficient we mean that from the group of the 14 young girls who had the opportunity to count on the special support of the school and the tutor, 11 received the honour certificate of completion of the MOOC and gave very positive feedback on their willingness to pursue STEM studies. Finally, in the last section, we try to draw some conclusions and leave some comments that we find relevant.

⁵See in <https://fostwom.eu/>

⁶<https://heroicjourneys.life/journey-heroine>

2 FOSTWOM project (2019–2022)

MOOCs are a vivid and innovative field of experimentation. The COVID-19 pandemic helped quicken some development areas because of the high demand for online content. Then after the pandemic emergency, the “new normal” became a hybrid approach to learning experiences. This means MOOCs continue to occupy a relevant position worldwide and offer many learning opportunities. These opportunities, however, come with their own limits and are often still keen to divide learning opportunities into silos: scientific content on one side is targeted for STEM male students, and arts and humanities content is aimed at a female public with social and cultural concerns [3]. MOOCs’ gender stereotypes and under-representation of women in STEM affect the way girls and young women perceive themselves and their intellectual skills, and it is one of the reasons for their limited presence in the STEM field [1]. Believing that MOOC and gender-balanced educational content in general can be part of the solution, the FOSTWOM Project (2019–2022) developed a toolkit open to MOOCs stakeholders, content experts, instructional and graphic designers, that could guide them to create more inclusive STEM MOOCs. The result ended up being an offer of a practical tool to all people willing to create educational content from a gender-conscious perspective. METID team, in collaboration with other FOSTWOM partners, then designed and produced a MOOC for educators presenting the toolkit. In the MOOC “Fostering Women’s Participation to STEM through MOOCs”⁷, aside from a general reflection on educational content based on the toolkit and with a particular focus on content choices and storytelling to be used, gender-aware language, gender-aware use of images and visual materials; participants can also listen to the voices of people who work for a more inclusive environment in the STEM field. This MOOC was launched in 2021 for the first time on POK (Politecnico di Milano), and since then, already ran several times there, and once on MOOC Técnico (Instituto Superior Técnico of University of Lisbon), UPVx (Universitat Politècnica de València) and edX.

Then, a second MOOC was designed and produced within the FOSTWOM Project, the “Machine Learning, Maths & Ethics: Hands-on”, with its first edition (2021) launched on the MOOC Técnico platform⁸. As the MOOC’s teaser reads: “The course allows you to develop practical skills to build algorithms and stimulate critical thinking on the ethics of machine learning models. Did you know that nowadays girls and women are still under-represented in the fields of computer science, artificial intelligence and machine learning? We expect this MOOC to be

⁷https://www.pok.polimi.it/courses/course-v1:Polimi+FWM101+2022_M7/about

⁸<https://courses.elearning.tecnico.ulisboa.pt/courses/course-v1:MOOCs+lematecX+2021/about>

a meaningful learning opportunity to empower young people, especially young women to follow these areas of expertise.” In creating this FOSTWOM online course, the MOOC Técnico team followed the guidelines of the toolkit and the previous experience of the partnership in order to introduce a gender-conscious perspective in narratives, language, and in the use of images. This MOOC was subsequently launched on the platforms POK and UPVx in 2022.

3 The Machine Learning, maths & ethics MOOC in Recreio (brazil)

In the second edition (April 2022) of the course “Machine Learning, Maths & Ethics: Hands-on” on MOOC Técnico⁹, an effort has been made to translate every text, video transcript and assessment activities into Portuguese. Moreover, a software embedded in the MOOC allowed any person enrolled in the course to follow the path of a Heroine’s Learning Journey (HLJ) which functions as a motivational narrative metaphor for the internal challenges of (female) STEM students, trying to overcome their own fears and challenges in a STEM educational environment and become better learners. During this second edition of the MOOC, with 366 participants enrolled in total, additional resources for the day were provided, such as a Discord group for discussion, a YouTube channel for additional and optional lessons, extra support by two tutors dedicated to the course discussion forum, and for conducting optional assessment activities.

By the time the course was being advertised online in Portugal and Brazil, a high-school teacher from the city of Recreio-MG, Brazil, became interested in bringing the initiative to his city from a region in the interior of Minas Gerais. In order for some young female students to participate in the course, it was necessary to partner with the Olavo Bilac State School. The school provided the computer lab so that students could participate in the course, since a large part of the girls did not have devices and internet access at home. Additionally, for this special context, an online course tutor, a teacher assistant from the Federal University of Rio de Janeiro (Brazil), was made available, who set aside one day a week to provide synchronous sessions to the Recreio participants and created a WhatsApp group for facilitating communication.

In total, 30 young high school girls applied for participating in the experiment, filling in the initial form for attending the MOOC plus the lab training, made available by the schoolteacher, two months before the course started. After a previous

⁹<https://courses.elearning.tecnico.ulisboa.pt/courses/course-v1:MOOCs+lematecX+2022/about>

selection based on profile and self-motivation, 14 young women¹⁰, aged between 15 and 21 years old, were selected for having the opportunity of the three-month training with the MOOC “Machine Learning, Maths & Ethics”, and from them 11 girls completed the course receiving the honour certificate from Instituto Superior Técnico of the University of Lisbon. Notice that from the total number of 366 enrollees in the second edition (April 2022) of the MOOC, 67 certificates were issued at the end, which makes the rate of 11 out of 14 young women obtaining the honor certificate of the MOOC even more impressive.

In June 2022, a survey was conducted in Olavo Bilac State School. Several young girls, who participated in the training, voluntarily submitted their answers to the survey. The average age of these young women was 16.5 years old. The survey questions were as follows: socio-demographic questions (3), degree of satisfaction with the training and the corresponding supports (3), perceived relevance of the training (1), difficulties experienced during the training (1), and future expectations (2).

In this participatory experiment with Brazilian girls, we can clearly identify two important strategies that act as strong motivators to increase the number of women in the STEM area. These motivators, that is, indicators of a positive influence on gender balance in STEM, corroborate what is written in the scientific literature. The first indicator is the support of the school, teachers, and family. In the blended training carried out in the Recreio school, we consider that the possibility of using the lab computers was fundamental. According to [2], school support was reported as a determining factor for girls to choose to major in engineering. The school environment favours the empowerment of girls by increasing self-confidence about their abilities to work in STEM topics. Such exposure also helps to overcome the fear of disciplines that, due to gender stereotypes, are considered (more) suitable for men, such as maths.

In fact, one of the biggest learning difficulties reported by the young women, when they started training, was mathematics. Several times during the training, the tutor helped the girls overcome computational and programming difficulties and actually had a positive impact giving the girls courage to surmount the initial difficulties. As a result, on the mid-training survey, 62 % of the young women stated that they were considering working in the technology field and 75 % considered continuing to improve their knowledge in STEM in the near future. We can identify in this experiment the other strong motivator for bringing gender balance to STEM, which is the existence of role models [5, 4]. We can see in the presence and performance of the tutor, a young researcher from the University of Rio de Janeiro, a strong impact of a role model, providing the young women assistance and giving them the self-confidence that they so desperately needed.

¹⁰This was the actual computer lab capacity.



Figure 1: Young women participants with school A teachers from Recreio-MG/ Brazil

In general, strategies on role models occur when girls have direct or indirect contact with women working in STEM, through lectures and discussions in which these women's careers and challenges are discussed [5, 4]. It was already observed that the presence of actual women in STEM stimulates girls to participate in programming workshops [5]. Even more, having female scientists sharing their experiences and challenges with high school girls and undergraduate students has a positive effect on their feeling of belonging in STEM and encourages them to pursue their studies and careers [6].

4 Conclusion

With this unique experiment, although limited in number, with high school girls from the city of Recreio-MG in Brazil, we could clearly identify at least two important strategies that can play the role of strong motivators to increase the number of women in STEM careers: School support and contact with role models in STEM



Figure 2: Young women receiving MOOC support in Recreio-MG/Brazil

careers. These are positive factors that can inspire young girls to feel that they belong in STEM and give them the self-confidence to pursue their studies in the field. We want to emphasize that this experiment was made possible by the (re)use of a MOOC designed to be inclusive, avoiding the standard stereotypes on gender skills, and of a HLJ motivational narrative created to help overcome the internal challenges of (female) STEM students.

The authors of this short paper as co-creators and instructional designers of MOOC content, as active partners in the FOSTWOM project and as co-creators of the Heroine's Learning Journey, feel very grateful for the opportunity of seeing their efforts translated into real changes in the lives of the Brazilian girls. Despite the fact that it is not always easy to have the human resources and the institutional support to do that, we will do our best to take this experiment to more students and schools.

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