

European Virtual Exchange (EVE): Student Mobility without Moving

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Abstract. Universities are striving to provide a more flexible educational offering and at the same time to improve their internationalization strategy. EVE (European Virtual Exchange) is a program created by a consortium of seven European universities with the aim to offer a set of courses with mutual credit recognition to their home students, but without the need to travel to the host university, and with the possibility to combine courses from several host universities. Courses offered as part of EVE are regular undergraduate or postgraduate courses in their host university. However, they include a fully online version of the course for EVE students to take them, as well as regular synchronous encounters between teachers and students through videoconferences. Exams are created and evaluated by the host institution, but students take them in a face-to-face traditional way, with supervision by staff from the students' home institution. This paper presents the experience of offering and teaching a course on Data Structures with Java by Universidad Carlos III de Madrid (UC3M) as part of the EVE program. This course has been part of EVE for two consecutive academic years with 24 students overall. The course deploys its main content in a local instance of the Open edX platform, bringing together regular UC3M students who take the face-to-face version of the course but get the virtual version as extra support, and EVE students.

Keywords: student mobility, internationalization, MOOCs, e-learning

1 Introduction

Internationalization has become a priority for many universities, not only as a way of alleviating the strong global competition that currently exists in higher education, but also as a way to actively participate in the transfer and generation of global knowledge [1]. According to the OECD, having a high number of international students means being able to benefit from the contributions they can make to local research and development [2]. Internationalization can be measured from different perspectives: from the point of view of research (e.g., number of international projects granted, number of international recognitions, etc.), from the point of view of the university staff (e.g., number of international staff hired, staff's international experience, etc.), or from the point of view of academic programs and students (e.g., number of international students, number of courses with an international component, number of joint teaching programs, etc.) [3].

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There is a belief in the academic world that a large number of joint programs through international agreements entails a greater prestige for the educational institution. However, maintaining a large number of international agreements typically involves major investment in terms of faculty members, departments, and internationalization offices, often reflecting paper-based agreements and not productive partnerships [4]. Quantity does not necessarily reflect quality if it does not go hand in hand with comprehensive and sustainable relationships.

In recent years, the growth of online courses and full online programs has contributed to improve the internationalization strategy of many educational institutions worldwide. For example, MOOCs (Massive Open Online Courses) have made it possible to obtain a global outreach for local academic practices [5], with some MOOCs reaching out to students from nearly every country on earth [6]. Taking MOOCs (and the lessons learned from them) as a basis, different approaches related to the internationalization of higher education institutions emerge. For example, edX MicroMasters are programs where learners from anywhere in the world can complete a set of online courses offered by a host institution, earn a MicroMasters credential, apply for a (typically) one-semester residential master's degree program with recognition of the online courses already passed previously through edX [7]; in this case the aim of the host institution is to improve its internationalization strategy by attracting students from other countries. Another example is the creation of hybrid degrees in which one institution (host institution) transforms or creates a program composed of a set of MOOCs provided by an external institution [8]; in this case the aim of the host institution is to leverage the knowledge of an external (and usually international) institution and reuse its content by focusing on supporting its local students. This latter approach may require signing agreements between the host institution and the external institution, although if courses and contents are published under open licenses these agreements may not be required for content reuse [9].

A third approach that has been used to increase the internationalization of higher education institutions by taking advantage of online courses is the European Virtual Exchange (EVE) [10]. In 2017, seven higher education institutions (École Polytechnique Fédérale de Lausanne, Technische Universiteit Delft, Leiden University, Wageningen University & Research, Université Catholique de Louvain, Universidad Carlos III de Madrid, and Sorbonne Université) from five European countries (Switzerland, The Netherlands, Belgium, Spain, and France) formed an alliance so that students from any of these institutions could take courses from other institutions belonging to the EVE alliance (and get credits after passing these courses), but without the need to travel (see Figure 1). The implementation of EVE required some prerequisites for the above mentioned seven universities: 1) all universities taking part of this alliance had experience developing MOOCs, so they were ready to offer courses entirely online as part of their educational offering; 2) each university committed to offer a set of courses (updating the list of courses offered annually), so that students enrolled in other universities could choose and take them; 3) each university committed to recognize credits to their students who passed courses from other universities; 4) face-to-face exams were necessary to determine whether a student passed a course or not, these being designed by teachers from the host institution and proctored by staff from the home institution.

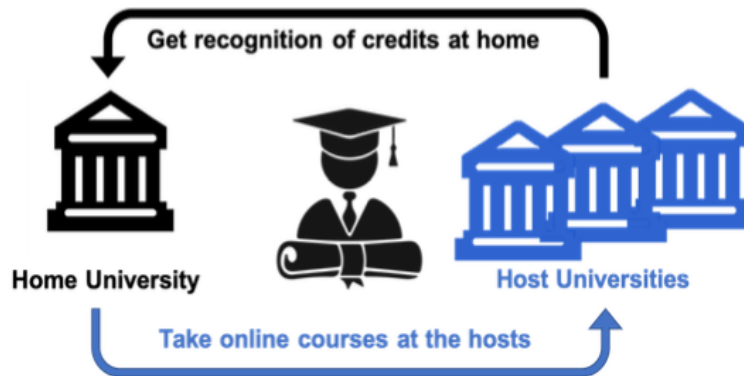


Fig. 1. European Virtual Exchange (EVE). A student can take credit-eligible online courses at the host universities and get credits at his home institution if passing them.

EVE terminology applies from the student's point of view and from the institution's point of view. From a student's point of view “*home institution*” refers to the institution in which the student is enrolled, and “*host institution*” refers to the institution in which the student takes an online course. From an institution's point of view, “*outgoing students*” are local students who take online courses from another institution belonging to EVE, while “*incoming students*” are external students who take online courses offered by the local university.

The advantages of EVE for students include: 1) having a larger set of courses to choose from in order to complete their undergraduate/postgraduate training; 2) benefiting from the international experience of professors from other universities, as well as from the cultural diversity of meeting students from other countries and institutions; 3) having a flexible learning experience, as the contents are available online at any time; 4) experiencing different methodologies and academic systems from other universities and from other countries; 5) practicing other languages, (depending on the languages of the courses the students take and that of the host university) [10]. The advantages of EVE for higher education institutions include: 1) enlarging their experience in online learning, sharing best practices with other leading European universities; 2) promoting local teachers and methodologies in a European context, as well as increasing their visibility; 3) reinforcing their educational offering with courses on top know-how domains in which members of the alliance stand out [10].

Quality assurance is essential in EVE. In order to guarantee the quality of the courses offered by members of EVE, it is important to emphasize that the structure and contents of these courses must be the same as those taken by the regular students at their home institution. Likewise, students who take the course online as part of EVE get ECTS credit by passing a course, this number of credits being up to the ones that regular students get in the host institution if passing the course. Moreover, the exams students need to pass to get credit recognition are always proctored exams. Finally, it is important to bear in mind that EVE builds on years of collaboration between universities in international student mobility as part of the Erasmus program.

The aim of this paper is to share the experience of offering a course on *Data Structures with Java* (officially called “Systems Programming”) through EVE for two consecutive academic years, as the authors were also the instructors of this course. The lessons learned from this experience are presented from the instructors’ point of view, considering that these instructors belong to a host institution which receives incoming students from other institutions that are part of EVE. The visions from other stakeholders (incoming/outgoing students, professors from the home institution, international relations offices, etc.), although might be of interest, are outside the scope of this paper. Next, section 2 presents an overview of the course as it was offered to incoming students in EVE, detailing its structure, types of contents, evaluation system and communication mechanisms between teachers and the students. Section 3 presents the lessons learned by the instructors after receiving incoming students in their course for two consecutive academic years. Finally, section 4 presents the conclusions of the paper.

2 Overview of the EVE course in Data Structures with Java

The course on Data Structures with Java offered by Universidad Carlos III de Madrid (UC3M) through the EVE program for incoming students, and officially named “Systems Programming”, has the same structure as the equivalent face-to-face course taken by regular UC3M students. The course lasts for a four-month period, allows for the recognition of up to 6 ECTS credits, and is divided into ten modules (three modules related to object-oriented programming, one module on testing, one module on recursion, four modules on linear and non-linear data structures – linked lists, stacks, queues, and trees – and one module on searching and sorting algorithms). This same ten-module structure is replicated in a local installation of Open edX (see Figure 2), the platform through which incoming students can follow the course online, and which is used by regular UC3M students in an integrated way with face-to-face sessions [11]. Both incoming students and regular UC3M students have direct access to Open edX through institutional credentials which, in the case of incoming students, are automatically generated when they enroll in any of the UC3M courses offered through EVE. In addition to the Open edX platform, both incoming students and regular UC3M students have access to a Moodle platform (called “Aula Global”), which acts as the institutional Learning Management System, and in which students can find complementary materials related to the course and the institutional administrative procedures.

As far as the contents of each module are concerned, these are of various types and include: 1) videolectures (explaining the main concepts through short videos uploaded to YouTube and linked from Open edX), 2) automatic correction formative exercises (using built-in Open edX tools such as multiple choice, checkboxes, drag and drop, drop-down lists...); and 3) programming exercises in which students need to develop a code or full program using the Codeboard development environment, which is seamlessly integrated into the Open edX platform [12] (see Figure 2). All these contents have been reused from three MOOCs on Java Programming developed by the teaching staff and offered on the edX platform by UC3M [13]. The specific contents of each module for the EVE course in Data Structures with Java have been built from the contents of these three MOOCs.

uc3m | IT: IT.2b Systems programming (18/19) (T2) Help calario

View this course as: Staff

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Bookmarks

- > 1. Object-Oriented Programming I
- > 2. Object-Oriented Programming II
- > 3. Object-Oriented Programming III
- > 4. Testing
- > 5. Recursion
- > 6. Linear Data Structures
- > 7. Stacks
- 8. Queues
 - 8.1 Queues
 - 8.2 Linked-list-based implementation**
 - 8.3 Deques
 - 8.4 Priority queues
 - Solutions
- > 9. Trees
- > 10. Sorting

8. Queues > 8.2 Linked-list-based implementation > Implementation of a Circular Queue with Linked Lists (non-graded activity)

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Implementation of a Circular Queue with Linked Lists (non-graded activity) VIEW UNIT IN STUDIO

[Bookmark this page](#)

The objective of this exercise is to implement a circular queue based on a linked list.

Analyze the code provided in the editor below and complete it as necessary.

STAFF DEBUG INFO

Implementation of a Circular Queue with Linked Lists (non-graded activity) (External resource)

code() Project Edit View Actions Compile Run

Implement a circular queue with

- Root
- CircularLinkedList.java
 - CircularLinkedListTest.java**
 - MySimpleLinkedList.java
 - Node.java
 - codeboard.json (h)

```

1- public class CircularLinkedListTest {
2-
3-     public static void main(String args[]) {
4-         // TODO
5-     }
6- }
7-

```

This will display the output.

Input to your program (press Enter to send) Send

User: calario Role: Project owner Info: Submissions are forwarded to external platform codeboard.io

STAFF DEBUG INFO

[< Previous](#)
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Fig. 2. Screenshot of the EVE course in Data Structures with Java deployed in a local instance of Open edX. Course structure on the left side. Example learning sequence in the right side (top bar). Programming exercise with Codeboard in the right side (below the top bar).

Communication with incoming students is carried out both synchronously and asynchronously. Synchronous communication takes the form of videoconferences, which are held periodically, and aim to regularly inform incoming students about the functioning of the course and resolve students' doubts. In this way the problem of lack of face-to-face interaction can be alleviated through synchronous encounters. The group made up of incoming students is usually not as large as the group of regular UC3M students, so the videoconference schedule can be accommodated to the incoming students' availability. Asynchronous communication takes place through the course forum (either through Open edX course forum or Moodle course forum), and the aim is mainly to resolve doubts and establish a dialogue with students through questions and answers; general notifications are also sent to incoming students through the course forum.

The evaluation system of this course consists of a traditional face-to-face exam. Although there are numerous exercises in the Open edX platform where this course is deployed, these exercises do not count for the final grade, so they are simply formative exercises for students to practice and revise the main course contents. For the face-to-face exam, the teaching staff of the UC3M course on Data Structures with Java design an exam with a theoretical and a practical part which contain representative portions of all the course contents. A few days before the official exam date, the exam is sent to the students' home universities so that these universities can organize the face-to-face proctoring of their students taking this exam; the exam date is also agreed upon with all the incoming students (and their home universities) depending on their availability and considering a closed range of possible dates. Once incoming students finish the exam, their home institutions send it back to UC3M for grading. Next, teachers of Data Structures with Java grade the students' exams. The grades are then sent back to the home universities, indicating whether the student has passed the course or not, so that the (up to) 6 ECTS credits can be recognized locally for successfully completing this course. If students do not pass this exam, they have a second chance to retake another exam in the same academic year, which also applies to regular UC3M students. The management and transfer of the exams is done through a platform developed by UC3M IT services for the secure exchange of files between institutions belonging to EVE.

Incoming students taking this course on Data Structures with Java also receive other tools (developed specifically at UC3M) that can help them work on (and eventually pass) this course. The first of these tools is FlipApp [14], a gamified mobile app that replicates the same structure and contents as in Open edX and allows students to get virtual points as they work on the course content (only videolectures and automatic correction formative exercises). The videos can be watched both in the Open edX platform and through FlipApp to get virtual points, while the formative exercises must be done directly in the Open edX platform. In addition, incoming students can use a conversational agent, called Java-PAL [15], which works on Google Assistant. This conversational agent is designed to help students revise the course key concepts. In order to do so, the conversational agent asks questions related to the key concepts and provides examples on these concepts. This conversational agent mainly covers the contents of the first three modules of the course (on object-oriented programming) and the fifth module (on recursion), although it also covers basic concepts of the Java language, thus helping students who may not have acquired or forgotten these concepts to review them.

3 Lessons learned from offering the EVE course

The course on Data Structures with Java has been offered twice, in two consecutive academic years, to the institutions that are part of EVE. In the first year (2017/2018) there were 13 incoming students (12 from Technische Universiteit Delft, and one from Leiden University), of which six passed the course in the first exam and two passed the course after retaking the exam. The remaining five students, although they were enrolled in this course, did not take any of the exams and did not interact with the teachers throughout the course. In the second year (2018/2019) there were 11 incoming students (9 from Technische Universiteit Delft, and two from Wageningen University & Research), and the course is still running. Some of the lessons learned from this experience are highlighted next.

- *Regarding the number of (active) incoming students.* After two years offering this course as part of EVE it is worth noting that teachers have always worked with small groups (13 and 11 students, respectively), which facilitates interaction and the negotiation of dates for videoconferences and exams. However, it is also noteworthy that some of the students enrolled in this course did not show any interest, not having any interaction with the teachers, and not taking any of the exams. One lesson learned is to try to contact the home universities at the beginning of the course to analyze case by case why this lack of commitment may be happening for students who initially decided to enroll in the course. The fact that no tuition fees are required to enroll in courses offered as part of EVE may partially explain the lack of commitment of some students. This problem has been detected in other EVE courses as well.
- *Regarding the level of studies of incoming students.* The course offered corresponds to first-year undergraduate programs at UC3M, but the majority of incoming students were actually enrolled in post-graduate programs at their home institutions; for example, in the first academic year only two incoming students were undergraduate students. The fact that students come from post-graduate programs may entail that students have already developed higher self-regulatory skills, which would make it easier for them to face this type of courses [16], and would eventually result in less need for interaction with instructors and peers. One consequence of the high level of studies of incoming students is a virtually non-existent interaction with regular UC3M undergraduate students who take the equivalent face-to-face course at the same time, and who also have access to the same contents in the same Open edX platform. The lesson learned is the need to look for approaches that increase the interaction between EVE and regular students, for example, by organizing synchronous encounters through videoconference, inviting representatives from both EVE and regular on-campus students.
- *Regarding the background and motivation of incoming students.* Some of the incoming students had studied (or were studying) programs that had nothing to do with computing, but they detected the important need of this missing knowledge and they wanted to take advantage of the opportunity to learn programming through this course. Others had previous experience with other programming languages but wanted to learn Java. Finally, others had studied Java some time ago and wanted to

refresh (and improve) their knowledge. It is important to take into account that the course on “Data Structures with Java” is at the undergraduate level, but it is not an introductory programming course; it is actually the second course that UC3M students take, and therefore some prerequisites are needed. The lesson learned is that the high heterogeneity in incoming students’ background demands additional materials for newbies, in this case starting with programming from scratch (in our case we recommended a basic MOOC on edX also offered by UC3M [13]). Those who already had programming experience benefitted from a course design with many formative exercises in the Open edX platform for practicing and consolidating the key concepts.

- *Regarding the assessment of students’ knowledge and competences.* So far, a face-to-face examination has been used as the assessment system, this examination being a written exam on paper and pen. However, this is not the most effective way of assessing students’ knowledge and competences in such a course, so a lesson learned is that a practical exam or a transversal project delivery could be included as part of the assessment system. In the first case, the practical exam should be also supervised by members of the home institution, having the teachers from the host institution online to solve possible questions (this is already done in the case of the current written face-to-face exams). In the second case, there should be a defense to ensure the authorship of the project. Being a small group of incoming students, this option would be easily implemented. Finally, it is worth noting that when working in an international context such as this one it is important to consider the local public holidays and examination periods of each university and country when setting compulsory dates for students to be assessed, which can be tricky sometimes.
- *Regarding the overall management challenges.* An important management challenge is that enrolment periods may be different in the universities that take part in EVE, which demands extra coordination. Instructors do not know how many incoming students will be in the course until it is quite late. Actually, latecomers may still join weeks after the course has started. This challenge hinders the communication with the incoming students in the first stages of the course and the organization of the kick-off videoconference. It should also be noted that incoming students cannot access the course contents until they receive their institutional credentials from the host university, thus causing further delays (incoming students must be enrolled first for the system to automatically generate the institutional credentials). Likewise, the credit recognition by the home university can suffer some delays, requiring not only students’ grades from the instructors in the host university, but also the need to follow internal procedures for the corresponding approval and signatures collection from the international relation offices from both home and host universities. The positive side is the existing correspondence of ECTS credits between European universities which helps to know the number of credits to be recognized.
- *Regarding the overall experience.* The overall experience of implementing EVE in this course on Data Structures with Java has been positive, although there are some aspects to be improved as lessons learned, especially with regard to the interaction with (and between) students, the evaluation system, and the internal procedures of

the universities participating in EVE. The overall feedback received from the incoming students regarding the contents and operation of this course has also been positive. The fact that the course is offered in English facilitates that more students from other European universities express interest in enrolling; this is a difference compared to other courses offered in Spanish by UC3M as part of EVE, which are barely in demand. It is important to highlight that there has been a real impact between four universities thanks to this course on Data Structures with Java: UC3M, Technische Universiteit Delft, Leiden University and Wageningen University & Research. Finally, these are only preliminary findings as EVE has been conceived as a three-year project, so a more detailed evaluation will be done at the end of that period.

4 Conclusions

Current trends in education suggest the need for students to build more flexible curricula, especially in their postgraduate stage, mixing and matching courses that fit their gaps and needs (even if these courses are offered by different universities). Students should be able to choose from a wide catalogue of courses and educational modalities: face-to-face, blended, and online (including MOOCs) formats. In this sense, universities should take a step forward to allow more flexibility in the curricula, and to create powerful alliances with other higher education institutions, as a way of promoting their internationalization and allowing a more attractive educational offering to their students. Universities today do not need to have experts in all possible subjects; instead they can rely on allied institutions to be able to increase the courses they offer to their regular students, as well as the quality of education. EVE is a first step towards building such alliances and the course on Data Structures with Java is an example implementation which shows the feasibility of this approach, although there is still room for improvement considering the lessons learned that were distilled from the experience of running this course during two consecutive years.

Future lines of work to improve the approach followed in EVE include experimenting with the possibility of organizing face-to-face encounters with EVE students at the beginning of the semester (one or two days maximum at a specific location, for example, the one in which the host institution is located) to generate a sense of community and get students to know each other better. It would also be interesting to extend the alliance of universities that are part of EVE to other European countries and perhaps explore the extension of the alliance to non-European universities, with the difficulty that the value of the credit may not be compatible with the ECTS outside Europe.

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