INTRODUCTION

Social networks are already being exploited for searching, storing, and sharing knowledge, demonstrating that they are an efficient vehicle for social learning. Consequently, they could be implemented as a competent tool for formal learning. Twitter is among the 10 most popular online social networks, integrating a community of over 500 million users around the world. Twitter has already been used in several educational programs and evaluated as a positive teaching experience with an outstanding potential in academic and educational environments (1–6). However, there are scarce examples available in the literature about its use in science teaching and communication.

In this work, we present and analyze the application of Twitter to create an online space for communication and learning of basic microbiology. With this aim, a team of professionals in the field has imparted, to our knowledge, the first worldwide open access microbiology course via Twitter as a Tool for Teaching and Communicating Microbiology: The #microMOOCSEM Initiative.

Ignacio López-Goñi1*, Mª José Martínez-Viñas2, Josefa Antón3, Víctor J. Cid4, Ana Martín González5, Maryury Brown-Jaque6, Juan M. García-Lobo7, Manuel Sánchez8, Juan Ignacio Vilchez9, Tatiana Robledo-Mahón9, Marina Seder-Colomina10, Silvana Teresa Tapia-Paniagua11, Alma Hernández de Rojas12, Alejandro Mira13, José Jesús Gallego-Parrilla14, Teresa María López Díaz15, Sergi Maicas i Prieto16, Eduardo Villalobo17, Guillermo Quindós18, Sabela Balboa19, Jesús L. Romalde19, Clara Aguilar-Pérez20, Anna Tomás21, María Linares22, Óscar Zaragoza23, Jéssica Gil-Serna24, Raquel Ferrer-Espada1, Ana I. Camacho1, Laura Vinué24, and Jorge García-Lara25

1Departamento de Microbiología y Parasitología, Universidad de Navarra, Pamplona, Spain, 2Secció Departamental de Microbiologia, Universitat de Barcelona, Barcelona, Spain, 3Departamento de Fisiologia, Genética y Microbiología, Universidad de Alicante, Alicante, Spain, 4Departamento de Microbiología II, Universidad Complutense de Madrid, Madrid, Spain, 5Departamento de Microbiología III, Universidad Complutense de Madrid, Madrid, Spain, 6Departamento de Genética, Microbiología y Estadística, Universitat de Barcelona, Barcelona, Spain, 7Instituto de Biotecnología y Biomedicina de Cantabria, Santander, Spain, 8Departamento de Producción Vegetal y Microbiología, Universidad Miguel Hernández, Elche, Spain, 9Instituto del Agua, Universidad de Granada, Granada, Spain, 10Institut de Radioprotection et de Sûreté Nucléaire, Fontenay-aux-Roses, France, 11Departamento de Microbiología, Universidad de Málaga, Málaga, Spain, 12Instituto Español de Oceanografía, Centro Oceanográfico de Gijón, Gijón, Spain, 13Centro Superior de Investigación en Salud Pública, Fundación FISABIO, Valencia, Spain, 14Grupo de Docencia y Difusión de la Microbiología, Sociedad Española de Microbiología, Spain, 15Departamento Higiene y Tecnología de los Alimentos, Universidad de León, León, Spain, 16Departament de Microbiologia i Ecologia, Universitat de València, Valencia, Spain, 17Departamento de Microbiología, Universidad de Sevilla, Sevilla, Spain, 18Departamento de Inmunología, Microbiología y Parasitología, Facultad de Medicina y Enfermería, Universidad País Vasco, Bilbao, Spain, 19Departamento de Microbiología y Parasitología, Universidad Santiago de Compostela, Santiago de Compostela, Spain, 20Departamento de Microbiología, Medicina Preventiva y Salud Publica, Universidad de Zaragoza, Zaragoza, Spain, 21Departamento de Microbiologia, Universitat Autònoma de Barcelona, Barcelona, Spain, 22Hospital Doce de Octubre-CNIO, Madrid, Spain, 23Servicio de Micología, Centro Nacional de Microbiología, ISCIII, Madrid, Spain, 24Division of Infectious Diseases, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA, 25School of Medicine, University of Central Lancashire, Preston, UK

*Corresponding author. Mailing address: Departamento de Microbiología y Parasitología, Universidad de Navarra, C/ Irunlarrea nº 1, 31008, Pamplona, Spain. Phone: +34 948 425600. E-mail: ilgoni@unav.es.
†Supplemental materials available at http://asmscience.org/jmbe
Twitter. Here we assess the results of our experience of using this social network as a tool for teaching, promoting, and communicating scientific knowledge to a wide audience.

PROCEDURE

A total of 30 professionals were involved, all members of the Spanish Society for Microbiology (SEM, Sociedad Española de Microbiología), affiliated with 25 different universities or research centers located in different cities in Spain, France, the USA, and the UK. The layout of the course was elaborated and agreed on by discussion via e-mail with the Massive Online Open Course (MOOC)’s coordinator, who delivered some basic instructions to the rest of the virtual faculty members in order to ensure homogeneous material (see Appendix 1 for a course syllabus). Briefly, each participant prepared a lecture consisting of a series of 30 to 50 sentences (tweets), each one a maximum of 140 characters, often including links to diverse curated on-line free access content specifically generated for the course, web pages, news, and especially images or videos. Each tweet was to be written in Spanish, using simple and concise language, meant to communicate science to a general audience outside the academic environment. It was advised that humorous tweets be included periodically to emotionally involve and motivate the reader (see Appendix 2 for examples of representative tweets). Most of the lecturers spent more than three hours preparing the class. The hashtag #microMOOCSEM was created for this course: “micro” acknowledges both the subject under focus, microbiology, and the fact that it is conceived for the small 140-character format; “MOOC” for Massive Online Open Course; and SEM for the Society. Thus, each tweet included the #microMOOCSEM hashtag. The course took place over 10 weeks (April 5 to June 8, 2016), with classes scheduled every Tuesday, Wednesday, and Thursday at 22:00 h (GMT +1) so that they could be followed at convenient times in Spanish-speaking countries as the press and radio, in diverse locations around Spain, as well as healthcare and science professionals, journalists, and scientific communicators. To assess the acquisition of knowledge by the followers, we included three or four quiz questions (Appendix 1) at the end of each class, reaching a total of 78 questions that were answered by an average of 309 followers per day. Figure 2 ranks the questions according to the percentage of correct answers obtained.

RESULTS AND CONCLUSION

Comprehensively, the course consisted of 28 lessons plus a “Graduation Party” (Appendix 3), involving 1,225 tweets, 702 images, 265 hyperlinks to web pages, and 136 videos related to microbiology. Considering the total number of tweets and their release frequency, the total length of the course was approximately 20 hours. Certain classes became a Twitter trending topic in Spain. Figure 1 shows the number of Twitter daily impressions along course development. Some classes reached over 260,000 impressions and 3,700 retweets. However, data trend reaches a plateau in the number of impressions from the fifth week on, suggesting that longer courses may result in a decrease in followers. We could not detect a direct relationship between the number of impressions for a particular class and the day of the week, the social interest of the topic, or the number of images or videos included. Appendix 4 compares the monthly activity of the @SEMicrobiologia Twitter account before starting the MOOC to that in April, the month that marked a peak of activity. Before the start of the course, the number of followers for the @SEMicrobiologia Twitter account was 2,176, and the last day of the course it rose to 7,240 (Appendix 5).

The course has been followed worldwide: 62% of the followers were located in Spain, 29% were from Mexico, Venezuela, Argentina, Colombia, Peru, Ecuador, and Chile (from the most represented to the least), 2% in the USA and the UK, and the remaining 7% in other countries. Regarding gender, 61% of followers were female. The most represented followers were college and high school students, high school and higher education teachers, as well as healthcare and science professionals, journalists, and scientific communicators.

To assess the acquisition of knowledge by the followers, we included three or four quiz questions (Appendix 1) at the end of each class, reaching a total of 78 questions that were answered by an average of 309 followers per day. Figure 2 ranks the questions according to the percentage of correct answers obtained.

At the end of the course, a satisfaction survey was completed by the lecturers: all of them confirmed that this experience has been useful to improve their teaching skills and, at the same time, to learn new concepts related to microbiology in topics different from their own; they would recommend this course to their students and colleagues for technology-enhanced teaching and learning, and they would like to participate again in a similar course via Twitter.

The #microMOOCSEM experience demonstrates that, when properly used, Twitter is an excellent means for collaborative teaching and active learning, as well as for establishing professional networks and communicating science to society. With this first online Microbiology course via Twitter, we have proved that science lectures can be taught by this means to a wide interested audience in a highly interactive way, with immediate feedback, and
with the convenience of access from home or any place in which a mobile device has access to internet data.

SUPPLEMENTAL MATERIALS

Appendix 1: Table 1. Twitter course syllabus
Appendix 2: Figure 3. Image captures of representative tweets posted during #microMOOCSEM course
Appendix 3: Table 2. Structure of #microMOOCSEM lessons
Appendix 4: Table 3. Activity of the Twitter account @SEMicrobiologia before and after the course
Appendix 5: Figure 4. Evolution of the number of followers of the @SEMicrobiologia Twitter account

ACKNOWLEDGMENTS

The authors declare that there are no conflicts of interest.

REFERENCES