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## FROM BENCH TO MONITOR – TURNING ADVANCED LIFE SCIENCE COURSES INTO VIRTUAL

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### Abstract

The European Molecular Biology Laboratory (EMBL) provides advanced training for life science researchers in state-of-the-art technologies and fosters scientific exchange. The heart of the face-to-face advanced course programme is a strong focus on expert led hands-on training combined with theoretical and application lectures, as well as networking opportunities. Due to the pandemic, the face-to-face life science wet-lab and computational courses were converted into virtual formats. The courses are participant centred and focus on real scientific challenges and problems on the given topic. The need for these advanced molecular biology training courses is reflected by the high numbers of applications. Here we describe one solution to the virtual transformation of EMBL's course programme, including the first reactions of our international audience and the effect for the future of cutting-edge advanced training courses for lifelong learning in the life sciences.

### Introduction

Methodologies and technologies are rapidly evolving in the life sciences and other STEM (Science, Technology, Engineering and Mathematics) areas. It is key for scientists and academic researchers to stay up to date with the newest developments in their field and also beyond. One solution to overcome this challenge are lifelong learning opportunities. Novel advanced technology training with complex procedures requires particular focus through practical and hands-on sessions.

The European Molecular Biology Laboratory (EMBL) is Europe's leading life sciences organisation. An intergovernmental organisation of 27 Member States, EMBL operates sites in France, Germany, Italy, Spain and the United Kingdom. We conduct world-class life sciences research, provide training for students and scientists, and provide state-of-the-art research infrastructures for a wide range of scientific and experimental services. EMBL

pursues five core missions, including advanced training for external scientists through courses and conferences as well as a scientific visitor programme (source: EMBL webpage).

Each year EMBL offers up to 60 face-to-face training courses across its sites, providing life scientists access to the latest methodologies and technologies. The topics are diverse and range from cell biology, genomics, proteomics to structural biology, synthetic biology and bioinformatics. For efficient course delivery, approximately 30 of these courses are taken place in the EMBL's Advanced Training Center (Heidelberg, Germany), which harbours training laboratories and computational facilities. Most of the 4- to 11-day courses cover complete experimental workflows, from sample collection, to hands-on wet-lab methodologies, to computational data analysis. The course organizers, trainers and speakers are leading scientists in their research fields, from EMBL and world-wide. All courses receive many applications and positive feedback, as measured by the post-course surveys. The course reputation and quality are supported through the conceptual course design, and the practical and operational support offered by EMBL's external scientific training team.

Due to the Covid19 pandemic the EMBL face-to-face advanced course and conference programme had to be suspended. While the conferences resumed in a virtual format within two weeks, the courses needed more attention to implement their core principles and standards in live virtual designs. The aim was to transform the courses into a format where PhD students, postdocs and staff scientists receive training in cutting-edge hands-on methodologies paired with scientific exchange and networking to create a clear benefit to the scientific community.

Key challenges of the EMBL Heidelberg virtual transformation:

- Time zone management; trainers, speakers and also participants are located worldwide. A tool is needed to manage the various time zones and ensure live participation. In addition, the overall live online time period has to be adjusted to fit all course participants wherever they are.
- Consistency in course delivery; the organizers, trainers and speakers vary from course to course. A course template and various session templates are needed to ensure standards and quality of course content and the delivery.
- Identification of session modes and development of strategies that allow practical scientific methodology training and engaging activities.

## **Virtualization of EMBL's External Scientific Course Programme**

The heart of the EMBL course programme is a learner centred approach paired with engaging activities to foster discussions, scientific exchange and networking. The courses are addressing real scientific challenges and cases, with the aim to enhance the participants' engagement and learning. These elements are also key in the virtualization of the course programme and created the basis for the course designs.

Our technology focused courses address responsible conduct of research by adequate quality controls, standards in the field, advantages and disadvantages of the given methodologies. Generated data, processing and analysis apply the FAIR principles of data management (Wilkinson et al., 2016). Every participant has the opportunity to present and discuss their research project with the fellow participants and key experts in the research field. By integrating active learning principles, the participants also apply the gained knowledge and skills in complementary team activities that address scientific case studies (Laurillard, 2012). As for our face-to-face programme, the quality of the virtual courses is continuously monitored and improved based on organizer/trainer and participant feedback surveys.

Below we illustrate the implementation of our virtual course strategy by crucial sections of the conceptual design.

### ***Learning Management System and software tools***

For courses run at EMBL Heidelberg the software EMBL eCampus (EMBL, 2021b) is the centre of the virtual programme. It is a customized Moodle-based learning management system with Zoom integrations serving as a virtual classroom for the live sessions. The platform is hosted on EMBL servers and supported by an IT company called Wunderbyte.

To ensure quality of content and delivery as well as corporate design we invested in consistent course templates (addressed under course design). The participant engagement is supported by the integration of the plug-in tool H5P for creating interactive lectures and quizzes. Participants can interact and network via several options in EMBL eCampus prior to, during, and after the course. We tested integration of the messenger software Slack, which did not bring any advantage as compared to the integral EMBL eCampus tools. Networking and scientific exchange are important elements of EMBLs course programme. To facilitate these sessions, we make use of speed networking, online games like Pictionary or use interactive gathering tools like Gather.town.

### ***Course organizer and trainer support / templates***

EMBL's scientific courses differ in their scientific organizers and trainer teams. To ensure the quality of the virtual course delivery, we created template courses and programmes in EMBL eCampus. These programmes structure the course into an engaging learning experience and support the organizing teams in the virtual transformation of their advanced training courses.

Furthermore, EMBL eCampus itself provides an introductory course for trainers and organizers about the utilization of the platform. Organizers, speakers and trainers are supported by the external scientific training team throughout the course preparations and during the course.

### ***Course design***

Every programme starts with a live virtual onboarding session taking place about two weeks prior to the live sessions. At the onboarding session the organizers will provide a brief course overview and introduce the course structure and pre-course work also referred to as self-paced study material. This material consists of pre-recorded lectures, scientific methodology protocols (text and video format), and introductions to computational analysis, tutorials for various tools and software, and exercises. During the self-paced study time the participants can contact trainers for individual support and requests via EMBL eCampus communication means.

The live part of the course is approximately twice two hours per day and focuses on interactive and engaging sessions. Every virtual course starts with an introductory session on the course logistics, including key elements of the code of conduct and setting the scene. This is followed by another key element: the ice breaking activity, where course organizers, trainers and participants introduce themselves, their work including the challenges they are facing, and the expectations for the course. This activity reinforces discussions and networking and illustrates the common participants' challenges and expectations leading to an open and inclusive course culture. The live sessions of the course are structured in daily sub-topic specific outlines addressing the learning outcomes, participant time-zone adjusted agenda and course material.

Based on the course requirements for hands-on computational analysis sessions the participants receive cloud or virtual machine access with the requested software installations to guarantee a smooth completion of the self-paced and live learning exercises.

### ***Self-paced study material***

After the onboarding live session, the asynchronized course part starts, where each individual participant works through the self-paced study material based on their time convenience. This part focuses on the content delivery through pre-recorded lectures, protocol and methodology booklets and videos of the practical sessions. The complete content is provided through EMBL eCampus. Several trainers use this opportunity to align participants knowledge by providing exercises of different level of difficulty or pre-course assignments. One example is the pre-course work for computational practical sessions, where the participants acquire basic knowledge through exercises prior to the advanced live virtual sessions. Throughout the self-paced study time, participants can contact trainers and speakers via the forum or direct messaging on EMBL eCampus.

### ***Live virtual sessions***

The synchronized live virtual sessions focus on scientific exchange and active learning principles to achieve the long-term gains of the scientific content (Styers et al., 2018). The theoretical content of the self-paced period is addressed in either panel discussions or interactive sessions with the scientific experts. During the wet-lab practical live sessions, participants have the opportunity to follow selected critical steps of the methodologies streamed from the laboratory or scientific facility. The workflow always tries to answer real scientific problems, which is enhancing participants' engagement. Depending on the course, the illustrated technology and feasibility, we grant the participants a remote access to the scientific machines e.g. microscope systems for hands-on practice sessions.

Another interactive session type consists of case studies. The participants are grouped into teams either randomly or based on their scientific background. Each team receives a different scientific challenge which they need to solve by implementing the gained scientific knowledge. On the last course day, each team presents their work and receives feedback from the other course participants and the trainers. These collaborative activities foster their transferable skills like critical thinking and working in a team.

In either poster sessions or student presentation sessions, the participants have the unique opportunity to present their own scientific project to the scientific experts and their fellow participants. These sessions provide every participant with additional valuable and appreciated feedback. The lively discussions can also lead to new projects or initiate scientific collaborations.

## **Conclusions of the virtualization and outlook**

To overcome the key challenges of the virtual transformation, we developed EMBL eCampus for the EMBL Heidelberg centred courses. EMBL eCampus is a customized platform combined with guidelines and templates to facilitate the virtual content delivery and course design for organizers and trainers. The virtual practical courses started in August 2020 and covered scientific topics like microbial metagenomics, *Drosophila* genetics and genomics, and the use of machine learning in image analysis. The very first virtual practical course on Cryo-Electron Microscopy in August 2020 received 333 completed applications for 24 participant slots. Thus far we delivered 12 virtual courses in the last 10 months. All together 1550 European and international scientists have applied for 244 participant slots, showing a clear need and interest for advanced training in cutting-edge research methodologies and technologies.

Each course, as well as the whole virtual course programme, benefits from the trainer and participant feedback and its implementation. The feedback survey is designed to collect anonymized quantitative and also qualitative (via open questions) data. We have so far analysed 10 virtual courses surveys. Overall, the virtual courses have a recommendation rate of 95.1%, which is comparable to the 2019 recommendation rate of the face-to-face delivered courses of 96.09%. We also asked the question “How did this virtual practical course compare to physical attendance at meetings?” to gain feedback for potential new course designs. Although 46.45% stated “not as good”, 41.95% rated the virtual courses as “about the same” and 11.2% “better”. Especially participants of computational analysis courses considered the virtual delivery format to be better. The open feedback often stated the reduced social interactions and networking opportunities despite our virtual course design efforts.

The digitalization of the EMBL Advanced Course Programme provides opportunities for the post-COVID time. Even though already prior to the pandemic we utilized social media and chat portals, we find that EMBL eCampus offers advantages and beneficial features that we plan to continue using once the face-to-face trainings are again possible. One opportunity is the self-paced study material that we aim to use during a pre-face-to-face course period to align the knowledge levels of our diverse audience. We are collecting further data to access this subject. Altogether, the pandemic has provided us the opportunity to digitalize our training programme, and this has opened up new formats and delivery modes for our advanced scientific courses.

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