EXCELERATE Deliverable D11.3

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Lead Beneficiary:	44. UCAM
WP Title	ELIXIR-EXCELERATE Training Programme
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WP leader:	Patricia Palagi; Gabriella Rustici; and Celia van Gelder	25. SIB; 44. UCAM; 6. NBIC
Partner(s) contributing to this deliverable:	1 - EMBL; 2 - UOXF; 4 - UNIMAN; 5- UTARTU; 6 - NBIC; VU; SARA; 11 - UMA; 16 - FCG; 20 - CSC; 24 - UiO; 25 - SIB; 26 - CNRS; 30 - CNR; 32 - UL; 35 - MU; 40 - HUJ; 42 - FORTH; 43 - UEDIN; 44 - UCAM; 45 - UU; SU; 48 - WEIZMANN

Authors and WP contributors, on behalf of all WP11 members:

Terri Attwood, Daniel Ben-Avraham, Niall Beard, Victoria Dominguez del Angel, Pedro Fernandes, Kim Gurwitz, Pascal Kahlem, Eija Korpelainen, Brane Leskošek, Jessica Lindvall, Sarah Morgan, Stale Nygard, Patricia Palagi, Hedi Peterson, Gabriella Rustici, Susanna-A. Sansone, Milo Thurston, Celia van Gelder, Allegra Via.

Reviewers:

ELIXIR-EXCELERATE WP Leaders

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1. Executive Summary

The overall aims of the WP11 ELIXIR-EXCELERATE Training Programme were to: (i) **build a sustainable training infrastructure** for the ELIXIR's community, encompassing both technical infrastructure and training expertise, and (ii) **deliver training to the ELIXIR Community**.

The ELIXIR **training infrastructure** that was built consists of: (i) training evaluation methods and metrics, together with the Training Metrics Database, (ii) the ELIXIR Training Portal TeSS, (iii) an eLearning Platform and (iv) the Virtual Coffee Room. In addition, a crucial component of the training infrastructure is formed by the people involved in training, and more specifically, the ELIXIR Training Coordinators, a group of training representatives of each of the ELIXIR Nodes, that leads the implementation of the ELIXIR training strategy across Europe.

The Training Metrics Database[1], developed by the Quality and Impact subtask (WP11.1.1) streamlines the collection, storage, and reporting of training metrics data; it enables ELIXIR training providers to deposit, access, visualise, and report on the training feedback data and associated training event metrics. While ELIXIR Training Coordinators each have access-controlled login details to upload and manage their data, there is also a

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[1] https://training-metrics-dev.elixir-europe.org/

publicly available view of the database for anyone interested in accessing interactive summary reports of ELIXIR-wide training.

The ELIXIR Training Portal TeSS[2] (WP11.1.2) harvests training information from ELIXIR Nodes and 3rd-party content providers, allowing users to browse, discover and organise life sciences training resources. The number of TeSS content providers (68), Nodes (15), and users has steadily increased, and the number of training events and materials has grown accordingly[3].

The ELIXIR-SI eLearning Platform (EeLP[4], WP11.1.3) has been used to deliver asynchronous and synchronous training events. Since 2015, 27 e-learning courses have been run using EeLP and the Video conference system.

The Virtual Coffee Room[5] (VCR) was developed to be the central information exchange platform for ELIXIR and to ease the search of training materials and courses. It integrates popular communication platforms (Slack and Fleep), and supports the ELIXIR groups that are managed on the PERUN server.

Along with the training infrastructure, WP11 also developed and delivered training in topics that were identified as training gaps, in selected application areas, within the ELIXIR community. Within ELIXIR-EXCELERATE, 49 courses were organized for researchers (Train-the-Researcher, WP11.2.2), and 6 events were held for developers & operators (Train-the-Developer, WP11.2.1). Some of these events were co-organized by multiple WP11 subtasks; for more details on which subtask was involved in each event see: https://training-metrics-dev.elixir-europe.org/training-events.

The Train-the-Trainer subtask (TtT, WP11.2.3) built a community of expert trainers, to improve training capacity and further the impact of the ELIXIR infrastructure and resources. There were 27 TtT events, that took place in 13 Nodes and trained 385 trainers; the training materials are available online[6] and two articles were published presenting the TtT program and its impact[7].

A subset of TtR/TtT events includes 17 Software & Data Carpentry courses and 3 Instructor Training events that were organized as part of the collaboration established between ELIXIR and The Carpentries Foundation[8] to develop, and rollout, a strategy for computational skills training across Europe and build an ELIXIR Carpentries Instructor pool.

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[2] https://tess.elixir-europe.org/
[3] https://goo.gl/3X7viB,
https://drive.google.com/file/d/1GSIIHapOKRhS2kGL0Z_Jg7jACxqLCcjp/view
[4] https://elixir.mf.uni-lj.si/
[5] https://cafe.elixir.ut.ee/about/
[6] https://github.com/TrainTheTrainer/EXCELERATE-TtT
[7] https://f1000research.com/articles/6-1557, https://www.ncbi.nlm.nih.gov/pubmed/29028883
[8] https://f1000research.com/articles/6-1040

Furthermore, WP11 worked closely with different ELIXIR-EXCELERATE work packages, namely Tools (WP1, WP2), Data (WP3), Compute (WP4), Interoperability (WP5) and Capacity Building (WP10), as well as ELIXIR Communities (e.g. Marine Metagenomics and Rare Disease Use Cases). The Training Platform has also established collaborations with other global partners (e.g. BD2K, CODATA-RDA and GOBLET) to improve training and share best practices within and beyond ELIXIR's borders[9].

2. Impact

Training quality and impact assessment (WP11.1.1)

The Quality and Impact subtask has coordinated the harmonised collection of training metrics pertaining to training event details, training audience demographic, training quality, and training impact for ELIXIR- and EXCELERATE-badged training events held between 1 September 2015 to date. The strategy[10] for the collection of this information, including the specific metrics collected, was approved by the ELIXIR Head of Nodes on 12 December 2018 and has been commented on and adopted by the ELIXIR Training Coordinators as well as incorporated into the ELIXIR handbook of Operations[11]. The subtask is working on a publication outlining the strategy and intend to submit it for publication soon.

A key component of the strategy, and of the longevity of this data collection activity, has been the development of the ELIXIR Training Metrics Database[12], which streamlines the collection, storage, and reporting of ELIXIR training metrics data. In the database, ELIXIR Training Coordinators are able to upload and search training event and associated feedback data as well as generate interactive reports for their Node and for ELIXIR-wide training. In addition, a publicly available view of the database allows anyone interested to view summary reports of ELIXIR-wide training.

In order to populate the database with data collected before the launch of the database, the Quality and Impact subtask undertook a huge effort to consolidate data, and source all missing data, for all ELIXIR training events run between 1 September 2015 to 15 March 2019, corresponding to over 850 training events and associated feedback datasets, where feedback was collected from 19 ELIXIR Nodes. These events have all been uploaded to the database. In addition, the Training Coordinators are now uploading their training event and feedback data directly to the database. As of 31 July 2019, 986 events have been uploaded to the database. A summary of the ELIXIR-wide training metrics statistics may be viewed on the database Dashboard[13] a screenshot of which, taken on 31 July 2019, is shown below.
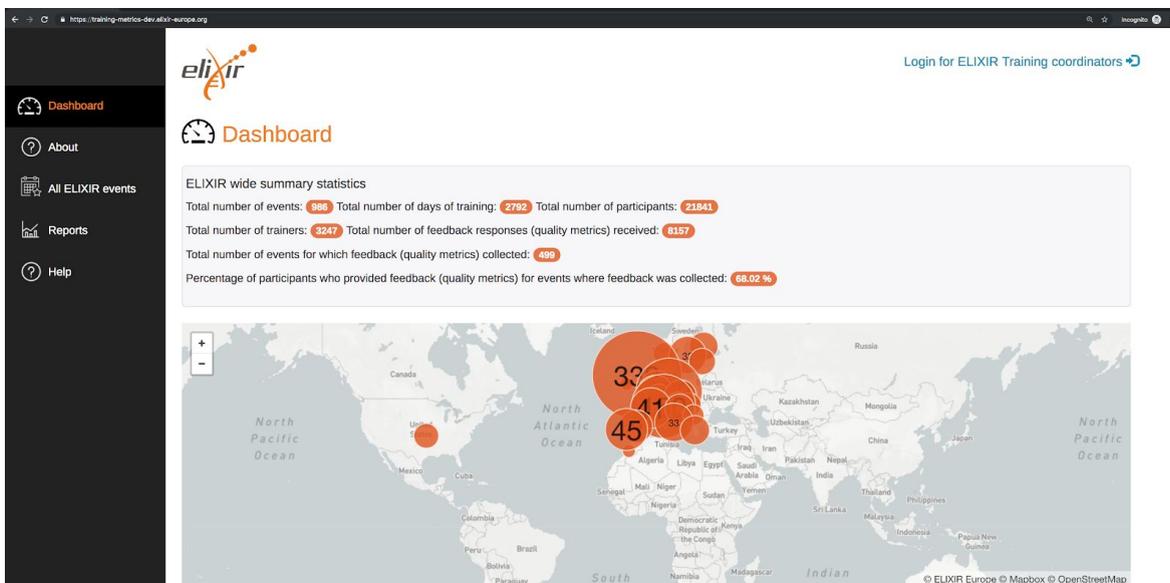
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[9] https://elixir-europe.org/platforms/training/collaborations
[10] https://docs.google.com/document/d/1BEP82K3Lg7ZpTgTU52djXlAe9Ocy-FNrS8hsSgKDTV4/edit
[11] https://drive.google.com/file/d/1RMFwtn-oSiaKweRJzgLixIgs87kMJK-j/view
[12] https://training-metrics-dev.elixir-europe.org/
[13] https://training-metrics-dev.elixir-europe.org

Screenshot of the Training Metrics Database Dashboard outlining ELIXIR-wide training statistics (Screenshot taken on 31 July 2019, https://training-metrics-dev.elixir-europe.org/).

In developing the training metrics strategy as well as the list of associated training metrics themselves, the subtask developed a set of project aims to ensure that appropriate data was collected. These aims, along with a summary of the findings for training events run from 1 September 2015 to 31 July 2019, is outlined below. Interactive reports detailing the below may be viewed in the Reports[14] section of the Training Metrics Database.

Training demographic and training quality:

For all ELIXIR-badged training events in the **short term** (i.e. directly after training), including train-the-trainer events, the subtask aimed to:

Aim 1: Describe audience demographic, and number of individuals, reached by ELIXIR Training Platform events.

Summary of findings for aim 1: Overall, 21841 individuals were trained by ELIXIR-badged training events. Of the 8157 individuals who provided survey responses (corresponding to 68.02% survey response rate), the majority are PhD candidates (44.8%) or Post Doctoral Researchers (26.1%) from academia/ research institutions (92.9%).

Aim 2: Determine the most used advertising channels for ELIXIR-badged training events to better understand what works well, but also to gauge whether the use and advertisement of TeSS[15] needs to be increased.

Summary of findings for aim 2: The majority of survey respondents heard about the training events through email (34.6%) and the host institution website (26.4%). Only 1.3%

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[14] https://training-metrics-dev.elixir-europe.org/all-reports

[15] https://tess.elixir-europe.org/

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were made aware of the event through TeSS suggesting that the use and/or advertisement of TeSS should be increased within the Nodes.

Aim 3: Assess the potential uptake of tools/resources covered in the training as the result of attending ELIXIR-badged training events.

Summary of findings for aim 3: 83.9% of survey respondents indicated that they would use the tools and/or resources covered in the training again.

Aim 4: Assess how satisfied participants of ELIXIR-badged training events are with the training and whether they would recommend the training to others.

Summary of findings for aim 4: 69.2% of survey respondents indicated that the training event they attended was 'Excellent' or 'Very Good' and 89.9% indicated that they would recommend the event to others.

Training impact:

For selected ELIXIR Nodes, that have the capacity to follow up with past participants and for selected course types (e.g. short courses, courses with narrower range of learning outcomes etc.), the subtask aimed to assess the following, **6 months to one/two years after training**, in 6 month intervals, in an effort to assess training impact:

Aim 1: Whether participants who attended ELIXIR-badged training events in the past have increased their usage of the resources/tools covered in the training.

Summary of findings for aim 1: 90.1% of survey respondents indicated that they use the tools and/or resources covered in the training 'frequently (weekly to daily)' or 'occasionally (once in a while to monthly)' in comparison to 'never' (45.8%) before having attended the training.

Aim 2: Participants' self rated confidence in using certain tools/resources since taking part in the training as well as how the training has helped with their work and whether this outcome aligns with participants' subjective desired outcome.

Summary of findings for aim 2: 55.7% of survey respondents indicated that they are able to explain to others what they learnt during the training and 83.2% are able to use the tools covered in the training by using the training materials covered in the training or independently. Survey respondents indicated that the training improved their ability to handle data (39.8%) and enabled them to complete certain tasks more quickly (31.4%). This seems to correlate with the reason for attending the training, with the majority attending training to learn something new to aid them in their current research/ work (46.8%).

Aim 3: Whether the training facilitated or led to useful collaborations, publications, submission of dissertations/theses for degree purposes, submission of grant applications, authoring of software.

Summary of findings for aim 3: The training facilitated many useful outcomes including publication of work (17.9%), useful collaborations with other participants/ trainers from the training event (15.2%), and submission of a dissertation/ thesis for degree purposes (10.4%). It is worth considering that a relatively short period of time had elapsed between course attendance and filling in this survey indicating that some of these outcomes likely require a longer timeframe, than one or two years, in order for them to be accomplished.

Aim 4: To what extent the course has been recommended and to what extent the learning has been cascaded to others.

Summary of findings for aim 4: Respondents indicated that they had already recommended the training to others or would do so (92.5%) and that they had shared the training with others (1-5 people: 48.5%; over 5 people: 11.8%).

To ensure that the impact of ELIXIR training is factored into wider discussions on ELIXIR's overall impact, the subtask has been involved in conversations regarding measuring the socio-economic impact and long term sustainability of research infrastructures through taking part in RI-PATHS[16] events, as well as through contributing to ELIXIR's long term sustainability plan[17]. The strategy and metrics developed within this subtask for assessing training quality and impact have been of interest to other EU funded projects such as EOSC-Life and the European Joint Project on Rare diseases. Through the role of ELIXIR in these projects, the strategy here presented is being tailored to address their needs and implemented in their training efforts.

3. Project objectives

With this deliverable, the project has reached or the deliverable has contributed to the following objectives:

No.	Objective	Yes	No
1	Deliver the coordination framework and trainer capabilities (train-the-trainer) needed for the pan-European ELIXIR training programme, and use this training infrastructure to build critical skills within data and service provision	X	

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4. Delivery and Schedule

The delivery is delayed: Yes   • No☑

5. Adjustments made

N/A

6. Background information

Background information on this WP as originally indicated in the description of action (DoA) is included here for reference.

Work package number	11	Start date or starting event:	month 1
Work package title	**ELIXIR-EXCELERATE Training Programme**		
Lead	44 - UCAM		

Participant number and person months per participant

1 - EMBL 14.00; 2 - UOXF 12.00; 4 - UNIMAN 30.80; 5- UTARTU 42.00; 6 - NBIC 7.50; VU 2.00; SARA 2.00; 11 - UMA 6.00; 16 - FCG 12.00; 20 - CSC 10.00; 24 - UiO 2.00; 25 - SIB 12.50; 26 - CNRS 1.50; 30 - CNR 29.08; 32 - UL 42.00; 35 - MU 11.30; 40 - HUJ 0.47; 42 - FORTH 6.00; 43 - UEDIN 0.44; 44 - UCAM 31.56; 45 - UU 0.00; SU 10.00; 48 - WEIZMANN 4.50

Objectives

WP11 has two principal objectives:

• To build a sustainable training infrastructure for ELIXIR's community - encompassing both a technical infrastructure and training expertise, as well as mechanisms for guaranteeing quality of training. (Task 11.1)

• To develop and deliver training in topics selected as training gaps within the ELIXIR community in selected application areas (namely WP6 to 9 Use Cases). (Task 11.2)

Work Package Leads: UCAM to replace EUDIN following submission of GA 2nd amendment on 31/1/2018. EUDIN termination following submission of GA 2nd amendment on 31/01/2018. Chris Ponting (up to 1/3/2017), Gabriella Rustici (since 1/3/2017) (UK), Celia Van Gelder (since 1/3/2017) (NL) and Patricia Palagi (CH)

Description of work and role of partners
WP11 - ELIXIR-EXCELERATE Training Programme [Months: 1-48]

UCAM, EMBL, UOXF, UNIMAN, UTARTU, NBIC, UMA, FCG, CSC, UiO, SIB, CNRS, CNR, UL, MU, HUJ, FORTH, UEDIN, UU, WEIZMANN

As medicine and the life sciences become increasingly centred on the generation, analysis and interpretation of big data, most science professionals will need to become more proficient in exploiting bioinformatics data and systems. The ELIXIR Community is estimated at 500,000 people, drawn from across the spectrum of individuals ranging from life scientists and bioinformaticians, to tool developers and infrastructure operators. This WP will up-skill European researchers focused on the WP6 to 9 Use Cases, who will be empowered to more effectively exploit the data, tools, standards and compute infrastructure provided by ELIXIR, and on ELIXIR-EXCELERATE developers and infrastructure operators.

This Training Programme will be the foundation upon which international bridges will be built, in order to harmonise efforts, to share resources, to avoid duplication/redundancy and to maximise effectiveness. Specific organisations and initiatives with which to collaborate may be (but are not limited to): GOBLET (the Global Organisation for Bioinformatics Learning, Education and Training), ISCB (the International Society for Computational Biology), and Software Carpentry Foundation, and also the training programmes of other ESFRIs such as BBMRI, EATRIS, and ISBE. Collaboration with GOBLET essentially provides a ready-made global gateway to ELIXIR's training resources, and will ensure that the foundations built by GOBLET are not duplicated – the leader of task 11.1.2 also leads GOBLET, assuring that their distinct roles will evolve in harmony. Close engagement with industry will be sought such as through the ELIXIR Industry Programme.

ELIXIR is a new research infrastructure in its implementation phase. The ELIXIR community as represented in the EXCELERATE consortium is very diverse in a number of aspects, including for example maturity of individual Nodes and level of knowledge and expertise. For workshops held in the context of EXCELERATE, we will always try to identify the relevant expertise from within the consortium; however, as ELIXIR develops cutting-edge infrastructure for life sciences, external experts will need to be invited on a relatively regular basis to contribute to the discussions. Their travel and subsistence will be supported by the grant.

A robust, high quality training infrastructure supporting ELIXIR resources and services will increase the impact and visibility of ELIXIR as a whole, ensuring that ELIXIR resources are introduced into industry and academia. It will catalyse and support the (self-) training of researchers, increase the impact of ELIXIR services, and facilitate scientific excellence.

All activities in this Training Programme will build on existing national training experience and expertise in the Nodes, and will complement, enhance, and disseminate these activities. Training activities will be closely aligned with the ongoing development of data infrastructure, standards, tools and services in each Node. This work paves the way for a later comprehensive, high quality and sustainable training programme to be rolled out over the entire ELIXIR Community.

The ELIXIR Training Programme targets the following distinct stakeholder groups:
- The ELIXIR community encompassing its partners, associated industry and SMEs (Task: 11.1)

- Developers and Infrastructure operators of ELIXIR's services (Task: 11.2.1)
- Users of ELIXIR's services (Task: 11.2.2)
- ELIXIR's trainers (Task: 11.2.3)

Task 11.1: Building an ELIXIR Training Infrastructure (161.3PM)

Subtask 11.1.1: Assessing training quality, good practice and impact (51PM)

ELIXIR Training needs to be timely, impactful, of high quality, and at scale. It will draw upon existing expertise in member countries that has yet to be combined under a unified structure. A Good Practice Coordinator will identify and deliver a framework of good practices throughout ELIXIR and ELIXIR-EXCELERATE. An initial workshop involving the ELIXIR Training Coordination Group (TrCG), industry/SMEs and other stakeholders will focus on defining specifications, metrics and key performance indicators to ELIXIR training. This subtask will build confidence for those seeking training (whether from academia, industry or other sectors) that ELIXIR training is being delivered to high standards, ensuring "best in class" training provision. It will also provide ELIXIR with a mechanism to capture and report on the impact of its training programme on the European and international level, and will harmonise across Nodes in standards, metrics and sharing of training materials. Development of well- structured training routes – through the use of workflows – embedded in online resources (WP11.1.2 and WP11.1.3) will specifically address urgent needs of WP6 to 9 Users and industry for cost-effective, time-effective, impactful training.

Partners: UK, EMBL-EBI

Additional resources required: Workshops €20,000

Subtask 11.1.2: TeSS Training Portal (57.3PM)

A training portal, TeSS, will be developed in this task to be an active forum for aggregating, disseminating and coordinating information on ELIXIR-EXCELERATE's training activities/materials, including those relating to ELIXIR's Core Resources. Building on the TeSS prototype being piloted by ELIXIR-UK, this task will 'harden' the prototype, harness the outputs from WP6 to 9's Use Cases and 3rd-party content providers, and synergise globally with GOBLET. Importantly, training information from all Nodes will be pulled into the TeSS, ensuring ELIXIR- wide coverage. The TeSS will enable registration and discovery of training activities/materials through multi-centre information aggregation, it will allow users to collect ('package') sets of materials/tools/data required for training, and offer workflows that allow related resources to be identified and harvested from source. The roles of GOBLET and TeSS are complementary: the former (a materials/course repository and trainer directory) acts as a feed to the latter (a resource aggregator and dissemination hub), obviating the need for ELIXIR-EXCELERATE to build its own repository. No mechanism currently exists via which users may either readily discover ELIXIR- EXCELERATE training events/resources (many of which are dispersed on websites across ELIXIR member states and beyond) and/or determine their relevance (e.g., what is the audience of this course (beginner, advanced, etc.), what is its duration, where is it being held, which course should I take next, etc.?). The added value of this task is therefore in coordinating and making discoverable ELIXIR-EXCELERATE training activities/materials, and surfacing information in ways that support user decisions and choices. We will ensure wide uptake by all stakeholders (from trainers and trainees, to resource providers and

developers, including those across industry/SMEs) via community-building events. This subtask will result in the release of the TeSS as an open resource, contributed to by the community, and shaped both by the community and by the outputs of ELIXIR-EXCELERATE's Use Cases (WP6 to 9).

Partners: UK, CH, PT, NL

Subtask 11.1.3: eLearning (53PM)

Distance training has become essential to reach large audiences spread over many countries, as is the case for the ELIXIR community. This task will survey the current technological and pedagogical options, the existing e- learning expertise and technology in the Nodes, and possible international partners (Coursera, edX, Udacity, GOBLET etc.). In concert with the ELIXIR training community, we will decide for the best and suitable e-learning strategy for ELIXIR and then proceed into implementing this strategy, which will complement the TeSS training portal. During this process we will develop ELIXIR e-learning expertise, which will be exploited to create guidelines and recommendations for future trainers. A major part of this task will be devoted to derive scalable training materials related to the WP6 to 9 Use Cases and ELIXIR resources, which will all be made available to the ELIXIR community of trainers, developers and users. The trainers will benefit when delivering their courses; developers and users will benefit from the availability of materials.

Partners: SI, NL, CH, PT, IL, FI

Additional resources required: Workshops €20,000

Task 11.2: Delivering training to the ELIXIR-EXCELERATE community (128.35PM)

Subtask 11.2.1: Train the Developer and Infrastructure Operator (45PM)

This subtask targets all developers and infrastructure operators who are developing and maintaining ELIXIR services, distributed over all Nodes and ELIXIR WPs (most notably WP3, WP4, WP6 to 9, and WP10). The main activities are: a) mapping the competences across the Nodes and analysing collected training needs from the technical people through internet queries, discussion rounds at the annual ELIXIR All Hands Meeting and within the technical coordinators group; b) providing targeted training based on the mapped needs as face-to-face workshops or webinars where applicable; c) implement a dedicated virtual community space to ease the communication between the developers and infrastructure operators across the Nodes. The aim is to have a virtual coffee room where issues regarding resource development and ELIXIR services can be shared and re-occurring problems can be easily noticed and solved. The virtual community will allow buddying up individual developers across the Nodes who are working on similar tasks but otherwise would not meet nor have discussion possibilities. On top of all the information gathered, specific training can be quickly delivered in response to identified needs. Improving developers' skills and enabling easy knowledge exchange across the community will have immediate impacts on the quality of tools provided by the ELIXIR community. With substantial competition among analysis tools and databases in the life sciences, better designed and executed services obtain greater visibility not only in Europe but worldwide thus further raising the awareness of ELIXIR services.

Partners: EE, EMBL-EBI, SE, IL, FI

Subtask 11.2.2: Train the Researcher (48PM)

It is essential that ELIXIR-EXCELERATE Users (e.g. in WP6 to 9) acquire skills that empower them to transform big data into meaningful knowledge. This Subtask will plug the training gaps using HPC facilities and expertise, specific cloud computing workflow training needs (WP4) and existing solutions, and the provision of training workshops. Life scientists, computational biologists, and bioinformaticians engaged in Marine Metagenomics, Plant Genotype- Phenotype interactions, Rare Disease and Biological Sample Collection research will be trained in domain-specific knowledge. To become independent and savvy users of the ELIXIR resources training will be given in: scientific programming, statistics, HPC, ontologies, workflows, data curation and annotation (WP3), as well as in the effective use of standards and FAIR data. Reproducibility in the life sciences is a rapidly growing problem. Targeted training is anticipated to improve experimental reproducibility, to empower scientists to address new avenues of research requiring big data analysis, and to cross-pollinate diverse disciplines with innovative analytical approaches. Training opportunities will be prioritised, in consultation with Industry/SMEs, and training delivery will be monitored (WP11.1).

Partners: ES, CH, UK, NL, SI, NO, PT, EL, FI Additional resources required: Workshops €140,000

Subtask 11.2.3: Train the trainer (35.35PM)

For the ELIXIR training to achieve maximum impact, adequate capacity to train in all Nodes is required. This task will train the trainer pool that already exists – albeit in a fragmented manner – across ELIXIR Nodes and to identify and train new trainers. It will build a highly skilled and coherent community of training instructors by initially surveying available training capacity and developing an appropriate train the trainer (TtT) framework. Using targeted surveys and drawing upon knowledge and skills from Nodes with greater experience (and with WP11.1), expertise will be developed in Nodes, for ELIXIR Core Resources and Use Cases, where training opportunities have hitherto been scarce. The task will deliver a framework and associated material and guidelines for training new trainers across ELIXIR, from both industry and academia. To enhance delivery, training will take advantage of ready-to-run virtual machines (VMs, developed within ELIXIR and/or in collaboration for instance with BioImg.org) and clouds, assisted by a workshop that gathers both trainers and infrastructure specialists from WP4.2. TtT sessions will accompany training courses in Marine Metagenomics (WP6), Plant Genotype-Phenotype (WP7) and Rare diseases (WP8) providing good practice, and guidance for prospective new trainers. TtT will build capacity whilst stimulating collaborations spanning ELIXIR Nodes and other stakeholders, including industry/SMEs which represent a currently unexplored resource.

Partners: IT, EMBL-EBI, SE, CH, FI

Additional resources required: Workshops €154,000

7. Appendix 1: Report on training provided across the ELIXIR community

This report provides a brief overview of the training events delivered during ELIXIR-EXCELERATE, sorted by the 3 subtasks: 11.2.1 (Train-the-developer), 11.2.2 (Train-the-researcher) and 11.2.3 (Train-the-trainer). These subtasks were supported by the activities of the training infrastructure, represented by the subtasks 11.1.1 (Assessment of quality and impact), 11.1.2 (TeSS training portal) and 11.1.3 (eLearning).

All training events and training materials delivered during ELIXIR-EXCELERATE can be found on the TeSS portal[18].

All training metrics collected for training events delivered during ELIXIR-EXCELERATE can be viewed in the Training Metrics Database[19].

Additionally here we collated links to all reports, milestones, deliverable and publications released during the course of the project. These already contain considerable details on the project's progress and achievements, so we refer the reader to these additional documents for more detail.

7.1. Reports
- **Period 1**
- **Period 2**
- **Period 3**

7.2. Deliverables

Deliverable D11.1: Deliver the identified evaluation systems and good practice guidelines for training. Deliver a TeSS platform and identify e-learning solutions

Deliverable D11.2: Report on the training needs identified across the ELIXIR community

7.3. Milestones

	Milestone Name	Lead	Due	Done
M11.1	Collect evaluation methods and metrics. Deliver developer and infrastructure operator workshops	UEDIN	12	✓

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[18] https://tess.elixir-europe.org/events?include_expired=true
[19] https://training-metrics-dev.elixir-europe.org/

M11.2	[Release TeSS version 1 with a selection of content and first feeds](#)	UEDIN	12	✓
M11.4.1	[Hold community workshops to survey and discuss e-learning specifications, selection of Use Cases, guidelines and evaluation methods](#)	UEDIN	12	✓
M11.7	[Review the first year TrT courses and their impact on TtT trainees post course](#)	UEDIN	12	✓
M11.3	[Release TeSS version 2 with improvements](#)	UCAM	30	✓
M11.4.2	[Hold community workshops to survey and discuss e-learning specifications, selection of Use Cases, guidelines and evaluation methods](#)	UCAM	30	✓
M11.5	[Community testing (i.e. running courses) of the e-learning solution and contents. Explore modules for connecting eLearning platform with bioinformatics tools, computing infrastructure and other LMSs. Test the eLearning platform with a selection of face-to-face courses and open educational resources (OER) for the ELIXIR-EXCELERATE Use Cases](#)	UCAM	30	✓
M11.8	[Hold a programming workshop and produce the accompanying core materials, building on the strong foundation established in ELIXIR Pilot. Train on ELIXIR infrastructures – HPC, cloud computing and programming– targeting the Use Cases WP6 to 9 users. Expand the virtual community space for developers and infrastructure operators to other training communities](#)	UCAM	30	✓

7.4. Publications

- [Developing a strategy for computational lab skills training through Software and Data Carpentry: Experiences from the ELIXIR Pilot](#) action
- [The ELIXIR-EXCELERATE Train-the-Trainer pilot programme: empower researchers to deliver high-quality training](#),
- [A new pan-European Train-the-Trainer programme for bioinformatics: pilot results on feasibility, utility and sustainability of learning,](#)
- [Defining a lingua franca for the ELIXIR/GOBLET e-learning ecosystem](#)
- [Advancing the international data science workforce through shared training and education](#)
- [Training bioinformaticians in High Performance Computing](#)

Subtask 11.2.1 - Train the Developer

This subtask has actively supported the communication platform, the Virtual Coffee Room (VCR), developed by UTARTU. The VCR is available for all ELIXIR users through ELIXIR-AAI or through local registration[20]. This platform was built mainly as a communication channel for developers and infrastructure operators, however other audiences (Work Packages, Platforms, Communities) have shown an interest in adopting it, which could happen in the future.

Six events were organized by this subtask:

Title	ELIXIR Node	Start date	Url to event page/ agenda
ELIXIR AAI Training for Relying Services	ELIXIR-FI, ELIXIR-CZ	24.04.2018	https://www.elixir-czech.cz/events/elixir-aai-training-for-service-providers-apr-2018
BioContainers Hackathon: Reproducible Bioinformatics	ELIXIR-FR	09.10.2017	https://www.elixir-europe.org/events/elixir-biocontainers-hackathon
European Galaxy Developer Workshop	ELIXIR-FR	16.01.2017	https://www.france-bioinformatique.fr/fr/evenements/EGDW2017
Software faster: From months to minutes	ELIXIR-EMBL-EBI	20.09.2016	https://www.ebi.ac.uk/training/events/2016/software-faster-months-minutes
Elixir Technical Hackathon : Tools, Workflow and Workbenches	ELIXIR-FR	18.05.2016	https://www.france-bioinformatique.fr/en/evenements/technical_hackathon
Hackathon Bioinformatique	ELIXIR-FR, ELIXIR-DK	24.03.2016	https://www.france-bioinformatique.fr/en/evenements/IFB-Elixir

Members of this subtask, as well as numerous other ELIXIR members, were active contributors to the BioHackathon series[21], and the Galaxy Training Network. The latter has organized, in collaboration with ELIXIR, several hackathons for training materials

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[20] at https://cafe.elixir.ut.ee/questions/
[21] http://www.biohackathon.org/

development. These have resulted in the development of a growing collection of Galaxy training materials[22], which have been taught in numerous face-to-face training events. This also includes training resources for Galaxy developers.

Subtask 11.2.2 - Train the Researcher

49 courses were organized for researchers, funded by ELIXIR-EXCELERATE. A subset consisted of 17 Software or Data Carpentry courses and 3 Instructor Training events that were organized as part of the collaboration established between ELIXIR and The Carpentries Foundation[23] to develop, and rollout, a strategy for computational skills training across Europe and build an ELIXIR Carpentries Instructor pool.

Additional training topics included: analysis of high-throughput sequencing data (genome assembly, metagenomics, population genomics, RNA-seq, ChIP-seq, single cell RNA-seq, variant analysis), advanced computing skills (HPC, cluster computing, using cloud and VMs in training), metabolomics, systems medicine and specific tools training (Galaxy, Chipster, R, Unix).

Several other courses for researchers have been delivered by ELIXIR Nodes, as in kind contribution to ELIXIR[24]. After ELIXIR-EXCELERATE, the ELIXIR Training Platform will continue to run training gap analysis on a regular basis to identify new areas were training needs to be developed. It will then facilitate the development of new training solutions in the areas of need and support the roll out of new courses as part of the next ELIXIR Work Programme (2019-2023)[25].

Subtask 11.2.3 - Train the Trainer

The Train-the-Trainer activities built a community of expert trainers, to improve training capacity and further the impact of the ELIXIR infrastructure and resources. There were 27 TtT events, that took place in 13 Nodes and trained 385 trainers; the training materials are available online[26] and two articles were published presenting the TtT program and its impact[27].

An ELIXIR Train-the-Trainer Exchange Programme was established in 2018 to support the exchange of trainers between ELIXIR Nodes, and complement the ELIXIR-EXCELERATE grant. This has helped build the ELIXIR trainers' community,

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[22] https://galaxyproject.github.io/training-material/
[23] https://f1000research.com/articles/6-1040
[24] These can all be viewed at: https://training-metrics-dev.elixir-europe.org/training-events
[25] https://elixir-europe.org/about-us/what-we-do/elixir-programme
[26] https://github.com/TrainTheTrainer/EXCELERATE-TtT
[27] https://f1000research.com/articles/6-1557, https://www.ncbi.nlm.nih.gov/pubmed/29028883

strengthen the links between ELIXIR Nodes and facilitate training capacity building across the ELIXIR infrastructure. In particular, the project enabled successful applicants to:
- attend a Train-the-trainer course as a trainee.
- travel to a different Node to participate in the delivery of a bioinformatics course as trainer, thus practicing the skills acquired in the Train-the-Trainer course.

The ELIXIR Train-the-Trainer Exchange Programme and ELIXIR-EXCELERATE grant were key to generate a cohort of new trainers, capable of delivering courses independently, facilitate knowledge/skill transfer among nodes, and promote the development of a network of trainers.

After ELIXIR-EXCELERATE, the ELIXIR Training Platform will continue to build trainers' capacity across Europe and will diversify the existing program to also include online TtT.

Subtask 11.1.2 - TeSS Training Portal

The ELIXIR Training Portal, TeSS, was developed to harvest training information from ELIXIR Nodes and 3rd-party content providers, to facilitate discovery of life-science training events and materials, and offer visual navigation tools ('workflows') to link ELIXIR core resources to training resources, and signpost their relevance to users (in terms of their target audience, duration, location, etc.). The value of the portal is thus in coordinating and surfacing training information in ways that support user decisions and choices.

TeSS content has grown significantly over the course of the project:

Year	Events	Materials	Nodes Represented	Content Providers Automatic	Content Providers Manual	Total Content Providers
2016	2874	284	1	9	0	**9**
2017	5950	495	12	27	7	**34**
2018	7279	794	11	32	13	**45**
2019	9505	1208	18	39	26	**65**

The TeSS user interface is a critical component in facilitating the discovery of available training opportunities; a set of widgets that can be embedded in third party websites, and display relevant training in a variety of styles, are also available. TeSS is integrated with other ELIXIR platforms (FAIRSHAring, bio.tools, Data Stewardship Wizard, Galaxy Training Network Platform) and the TeSS team has led the Bioschemas Training Group in

creating schema.org training specifications[28] and delivering workshops to facilitate adoption. TeSS can be seen as a hub for any kind of training-related information and has become a key tool of the ELIXIR Training Platform.

After ELIXIR-EXCELERATE, the ELIXIR Training Platforms aims to: 1) maintain and sustain the standard minimal features of TeSS, including critical dependencies with other ELIXIR registries and Nodes, with 3rd-party data and training content providers, etc.; 2) develop TeSS (i.e. add functional capabilities); 3) showcase, within TeSS, the training solutions available from all Nodes, both increasing their visibility and expanding the portfolio of TP's e-learning activities; and 4) to make all ELIXIR training best practices/guidelines available through TeSS.

Subtask 11.1.3 - eLearning - Training provided through the e-learning platforms

ELIXIR-SI eLearning Platform (EeLP)[29] is a Learning Management System (LMS) and permanent repository for learning materials, which hosts 27 ELIXIR-related e-learning courses. These EeLP courses cover 17 face-to-face (FTF) events, 3 synchronous online events (webinars), 4 combined face-to-face and synchronous online events, and 3 asynchronous online courses. Among the 27 EeLP courses, four are open-access courses - no registration is required to access these materials.

EeLP courses are listed in this table:

Event name (short)	Event name (full) with link to the EeLP course	Event type
GAAC2016	Genome assembly and annotation course 1	face-to-face (FTF)
utlb-I	Unix/Linux Tutorial for Beginners	FTF + online synchronous
ttt-lj-2016	Train-the-Trainer course	FTF
lcl-lj-2016	Linux Command line course 1	FTF
RNA-seq	RNA-seq data analysis using Chipster	online synchronous
microarray webinar	How to get the most out of your microarray experiment. A Webinar	online synchronous
utlb-2	Unix/Linux Tutorial for Beginners 2	FTF + online synchronous
hpcmlg2017	ELIXIR-EXCELERATE HPC	FTF

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[28] https://bioschemas.org/groups/Training/

[29] https://elixir.mf.uni-lj.si

	Train-the-Researcher course	
GAAC 2017_2	Genome assembly and annotation course 2	FTF
GAAC 2017_3	Genome assembly and annotation course 3	FTF
GEEel-2017	GOBLET / ELIXIR-EXCELERATE Workshop on e-learning	FTF
tth	Think Tank Hackathon	FTF
iltls-3	Introductory Linux Tutorial for Life Sciences 3	FTF + online synchronous
phpc workshop	Prace HPC Workshop 2018 - Parallel computing in bioinformatics research	FTF
GAAC 2018_4	Genome assembly and annotation course 4	FTF
CZ proteomics 2018	Galaxy Proteomics workshop Prague 2018	FTF
MMetagen NO_2018	Hands-on workshop in Marine Metagenomics	FTF
galaxy2018	ELIXIR TtR course: Basic genomics using advanced analysis tools	FTF
edc_ljubljana	ELIXIR Data Carpentry - Ljubljana	FTF
eswc_ljubljana	ELIXIR Software Carpentry - Ljubljana	FTF
GAAC 2019_5	Genome assembly and annotation course 5	FTF
how-to pathway	How to make a pathway	online asynchronous
metadynminer	Metadynminer webinar	online synchronous
Open access materials (no registration required to access the materials)		
DMDS in Practice	Implementation of Data Management Plans & Data Stewardship in practice	FTF
eLearning_ljubljana	ELIXIR e-learning workshop 2019 - Ljubljana	FTF + online synchronous
beacon	How to install and deploy Beacon	online asynchronous
cwlt	How to use Common Workflow Language	online

		asynchronous

EeLP is connected to the ELIXIR HPC and Cloud technical infrastructure and is used in several ELIXIR courses; one example being the Genome Assembly and Annotation (GAA), which has been run several times over the last few years.

E-learning tools and services can be used in many different ways to complement ELIXIR training methods. In the future, ELIXIR training courses could use e-learning services (e-learning augmented training) to enable course participants and trainers to concentrate fully on the content of the course, moving away from the complexity of local installation of tools and services needed for a course. Such e-learning augmented training should enable teachers to follow participants' progress during course execution remotely or in situ, either synchronously or asynchronously.

For every instance of e-learning augmented training environment, the chosen LMS would exchange metadata with TeSS - which will be the central interface where to find ELIXIR e-learning objects - while being connected to ELIXIR AAI, ELIXIR HPC and Cloud technical infrastructure and other specific tools and services. In such a way, a distributed network of e-learning augmented training environments would enhance the ELIXIR training ecosystem at the national, regional or global level.

For long term sustainability of ELIXIR e-learning it is important to have a specific e-learning community forum where e-learning information and experiences are exchanged. For that purpose, an ELIXIR e-learning group was established in January 2019 and will exist beyond the ELIXIR-EXCELERATE project. This group will set up and maintain the list of e-learning services and tools provided by the Nodes that will be displayed in TeSS, will provide an e-learning consultant service and will address issues such as transforming existing face-to-face course into e-learning courses or the needs of special e-learning tools or services for training events.

7.5. Conclusions

The ELIXIR-EXCELERATE grant was of crucial importance to:
- develop a training community for life sciences across Europe;
- establish key elements of the ELIXIR training infrastructure, including the training portal TeSS;
- galvanize and empower Nodes to provide high quality training;
- increase training capacity within Nodes;
- reach out to a higher number of ELIXIR users through training events;
- upskill ELIXIR users/researchers in data analysis methodologies and the use of bioinformatics tools and resources;
- define best practices, guidelines and impact/quality metrics that ELIXIR Nodes, as well as institutions outside of ELIXIR, can adopt to develop, deliver and monitor their training programs, in alignment with ELIXIR.

In its next Work Programme (2019-2023)[30], the ELIXIR Training Platform will further develop the infrastructure established during the EXCELERATE project. Summary details of the next work programme can be found on the ELIXIR Training Platform Webpage:

https://elixir-europe.org/platforms/training

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[30] https://elixir-europe.org/about-us/what-we-do/elixir-programme