DELIVERABLE 5.2 - SECOND YEAR REPORT

BioNT

MARCH 31st 2025

biont-training.eu

contact@biont-training.eu

Co-funded by
the European Union

About this report

Grant Agreement	101100604 - DIGITAL-2022-TRAINING-02
Action Acronym	BioNT
Action Title	Bio Network for Training
Deliverable	5.2 Second year report
Work package	5 Data analysis & Information
Dissemination level	Public
Authors	R. Alves, S. Di Giorgio, T. Müller, T. Ninkovic, A. O' Cais, L. Paladin, I. Paredes Cisneros, P. Samarakoon, approved by all BioNT partners
Delivery date	2025-03-31

Consortium members

Acronym	Partner
EMBL	EUROPEAN MOLECULAR BIOLOGY LABORATORY
BIOBYTE	BIOBYTE SOLUTIONS GMBH
HPCNOW	HPC NOW CONSULTING SL
UO	UNIVERSITETET I OSLO
UB	UNIVERSITAT DE BARCELONA
ZBMED	INFORMATION CENTRE FOR LIFE SCIENCE
RIcapacity	RICAPACITY GMBH
ALU-FR	ALBERT-LUDWIGS-UNIVERSITAET FREIBURG
EPFL	ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE

Table of Contents

Overview of the second year of BioNT

The BioNT consortium is dedicated to providing a comprehensive training program and fostering a community for digital skills relevant to the biotechnology industry and biomedical sector. With a curriculum tailored for both beginners and advanced professionals, BioNT aims to equip individuals with the necessary expertise in handling, processing, and visualising biological data, as well as utilising computational biology tools. Leveraging the consortium's strong background in digital literacy training and extensive network of collaborations, BioNT is poised to professionalise life sciences data management, processing, and analysis skills.

1. Overview of Progress and Achievements

During its second year, the BioNT project successfully transitioned from the establishment to the consolidation phase, strengthening its training program and implementing key improvements based on first-year learnings. The consortium delivered the second iteration of the basic curriculum and launched the advanced curriculum, reaching over 500 trainees.

Key achievements include:

- Successful delivery of the second iteration of the basic curriculum, incorporating improvements based on participant feedback and trainer experience
- Launch of the advanced curriculum with specialised workshops targeting technical leaders and innovators, 2 workshops delivered, 1 ready to launch
- Organisation of the BioNT Community Event & CarpentryConnect Heidelberg 2024, bringing together over 90 participants from 17 countries
- Development of translation framework and initiation of materials translation into German, Italian and Spanish
- Establishment of the Lhumos platform for hosting self-paced learning materials

This report details BioNT's progress in its second year, focusing on the consolidation and improvement of the training offerings. The consortium presents a comprehensive analysis of both the basic curriculum's second iteration and the launch of the advanced curriculum. The document includes detailed metrics on participation and impact, an overview of the growing collaborations and synergies with key partners, and the progress against established KPIs. The quality assurance measures and future plans are outlined, including upcoming workshops and the expansion of the self-paced learning offerings. The EC's recommendations from the mid-term report in 2024 are being carefully considered and will inform the project’s strategy moving forward.

2. Training Delivery and Impact

2.1 Basic Curriculum 2.0

The second iteration of BioNT's basic curriculum was strategically scheduled across Q4 2024 and Q1 2025, separate from the community event. This decision was made to maximise accessibility and learning opportunities: had these workshops been delivered during the three-day community event, they would have required parallel sessions, preventing participants from attending the complete curriculum. By spacing the workshops over several months, the consortium enabled participants to progress through the entire learning pathway while maintaining their professional commitments.

A key success of this iteration was improved communication and advertising, which led to a significant increase in the number of applications. As a result, the criteria designed for the participant selection were applied for the first time. The selection focused on small and medium enterprises (SMEs), professionals and job seekers. Additionally, the participation of those living and working in Europe was prioritised.

Each workshop in the basic curriculum has been refined based on participant feedback and instructor experience from the first iteration. The following sections present detailed accounts of the individual workshops, including specific improvements implemented and key performance indicators (KPIs). This is followed by a comparative analysis examining the evolution of the training program from its first to second iteration.

Bioinformatics Introduction 2.0: A practical introduction to bioinformatics and RNA-seq using Galaxy

The second iteration of the Bioinformatics introduction workshop was held over 4 half days, from September 10th to 13th, 2024. The workshop registration was managed via the CECAM platform, with 182 registrations received.

For the second iteration, the workshop was reduced from 5 half days to 4, with the "Data types and databases" content of the last day as optional, with the possibility of learning about these topics using the self-learning material created during the first iteration of the same workshop. Apart from this change, the organisation, content and technical tools used remained identical to the first iteration (see the deliverable for the previous iteration for details). The workshop was conducted entirely on the Galaxy data analysis platform, ensuring a straightforward experience for all participants and providing a solid foundation for their subsequent analysis journey. To ensure a smooth delivery of the workshop, resources from the Training Infrastructure as a Service (TIaaS) were requested. The course was accompanied by the training materials of the Galaxy Training Network (GTN). Only those who completed the pre-workshop survey and finalized their registration in CECAM were considered, resulting in 170 complete applications. From these, 61 participants were accepted based on the criteria of being a job seeker, having a connection to an SME, or being employed in a European country.

	Day 1	Day 2	Day 3	Day 4
Trainees	48	40	42	39
Trainer/helpers	5	7	7	6

Table 1: Number of trainees, trainers and helpers per each day of the second iteration of the workshop “A practical introduction to bioinformatics and RNA-seq using Galaxy”.

In comparison to the first run of the workshop, several updates and improvements were applied. For the second iteration of the workshop, each helper had a clear description of their tasks and responsibilities. As most instructors and helpers came from the same institution, they were placed in one location for improved communication during the workshop. The process of how certificates were granted was described more precisely, leading to a smooth execution of the process.

Certificates were granted based on active participation, which was ensured by providing a proof of attendance. This means participants needed to share the links to all Galaxy histories they created during the workshop. Additionally, they needed to fill out the post-workshop survey. In total, 27 participants requested and received a certificate.

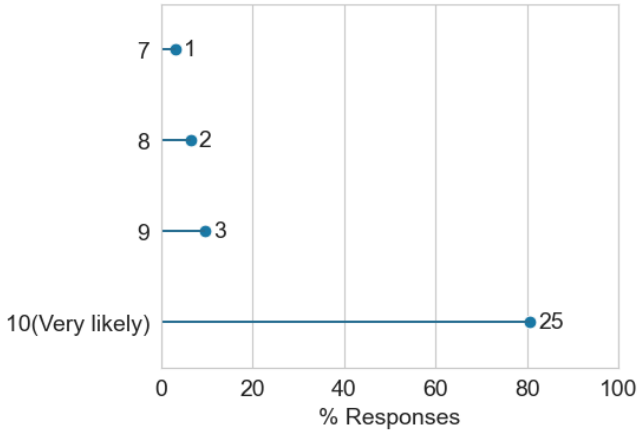

Figure 1: Responses to the question “how likely are you to recommend this workshop to a friend or colleague?” for the second iteration of the workshop “A practical introduction to bioinformatics and RNA-seq using Galaxy”.

The workshop feedback was very positive. Participants expressed their appreciation for the course as early as the daily feedback sessions. Immediate feedback, such as comments on the instructor’s speed, was addressed and improved during the course. However, on the final day, differences in participants' learning speeds led to some dissatisfaction. For the next iteration, a more thorough assessment of participants' skill levels or clearer communication that the course is designed for beginners could help better manage expectations.

The participants felt positive about the instructors answering their questions, being enthusiastic about the workshop, knowledgeable about the taught materials, and the participants felt good by interacting with the instructors. Almost all of the participants agreed or strongly agreed that they felt comfortable in the workshop’s learning environment, that

they can immediately apply what they learned during the workshop, and that they would recommend this workshop to a friend or colleague (see figure above).

One notable achievement of the second round was the significant increase in applications, nearly three times as many as in the first round. This allowed for a more selective process and closer alignment with the workshop's intended audience. As discussed earlier, the final participant group for the second round was primarily composed of individuals employed in European countries (59 vs. 2), which directly supports the project's goals and funding priorities.

Introduction to Programming Languages 2.0: From zero to hero with Python

The workshop introducing Programming Languages, called 'From Zero to Hero with Python', was delivered during the second round of the basic curriculum in two full days from the 17th to the 18th of October of 2024. In total, 107 participants registered via the event page for the course. Based on the same section criteria utilized for the Bioinformatics Introduction, 63 participants were accepted for the course.

For the second iteration, the program of the course stayed the same, but the additional GitHub Pages session was excluded from the course. The results of the first iteration of the course are available in the deliverable report. The GitHub Pages session was already available as self-learning material, which had been shared with the participants during the course. The learning materials of the course were taken from The Carpentries, and within the course, all 4 trainers were certified instructors of The Carpentries community.

Similar to the first round of the course, participants had the opportunity to attend open desk appointments to resolve any pre-installation and setup issues. Certificates were awarded to those who submitted their IPython notebooks containing the course content and completed the post-workshop survey. Out of 31 participants who requested a certificate, 30 were granted one.

	Day 1	**Day 2**
Trainees	44	38
Trainer/helpers	9	8

Table 2: Number of trainees, trainers and helpers per each day of the second iteration of the workshop "From zero to hero with Python".

Updates and improvements were made from the first round of this workshop. More upfront communication about the setup and installation requirements was provided before the workshop began. Additionally, the Code of Conduct was clearly communicated at the beginning to foster a positive learning environment for both learners and instructors. Although an out-of-office hours time slot was initially requested in a BioNT training survey and used in the first round, participant attentiveness improved by hosting the workshop during standard office hours.

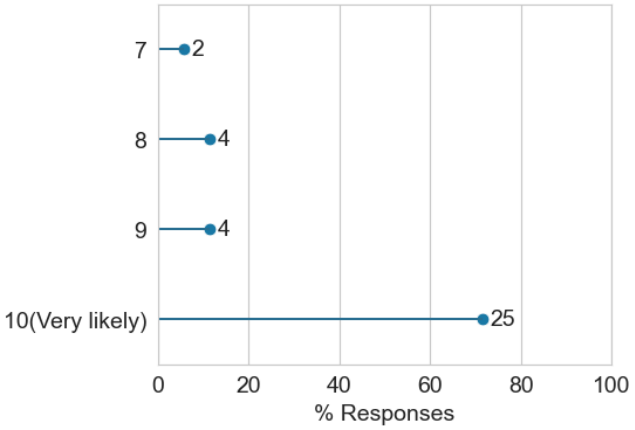

Figure 2: Responses to the question “How likely are you to recommend this workshop to a friend or colleague?” for the second iteration of the workshop “From zero to hero with Python”.

The feedback from the workshop was resoundingly positive. Participants expressed satisfaction with the instructors, noting their enthusiasm, responsiveness to questions, and comprehensive knowledge of the subject matter. Additionally, interactions with the instructors were perceived positively. The vast majority of attendees agreed or strongly agreed that the workshop's learning environment was comfortable, that the skills acquired could be readily applied, and that they would recommend this workshop to a friend or colleague (refer to the figure above).

A key achievement of offering this workshop a second time was the marked increase in applications, nearly two times as many as in the first round. This expanded applicant pool enabled a more selective process, helping align participation more closely with the workshop’s target audience. As described earlier, selection in round 2 prioritised applicants employed in European countries, ultimately resulting in a participant group of 49 individuals employed in Europe versus 14 from non-European countries.

Command Line and Cluster Computing 2.0: An introduction to high performance computing

The second iteration of the Command Line and Cluster Computing workshop was held over 2 days, on December 4th and 5th of 2024. The workshop registration was managed via the CECAM platform, with 62 registrations received.

For the second iteration, the workshop was reduced from 3 days to 2, with the “Introduction the Shell” content of the first day moved to a course prerequisite. Apart from this change, the organisation, content, and technical tools used remained identical to the first iteration (see the deliverable for the previous iteration for details). There were 2 instructors and 4 helpers throughout the workshop.

	Day 1	Day 2
Trainees	45	33
Trainer/helpers	6	6

Table 3: Number of trainees, trainers and helpers per each day of the workshop “An introduction to high performance computing”.

The workshop attracted an increase in the number of participants compared to the first iteration. There were no significant differences in the experience of the delivery or the general feedback from the participants (which was, again, largely positive).

24 workshop participants requested certificates. Certificates were provided to those who completed the pre- and post-workshop surveys and also completed the majority of the hands-on content of the workshop. Job submission data from the resource scheduler of the HPC resource used during the course was used to evaluate hands-on completion (e.g., job names, sizes, successful completion, resources requested, and resource consumption). 18 certificates were issued, with 6 rejected due to the insufficient completion of hands-on exercises.

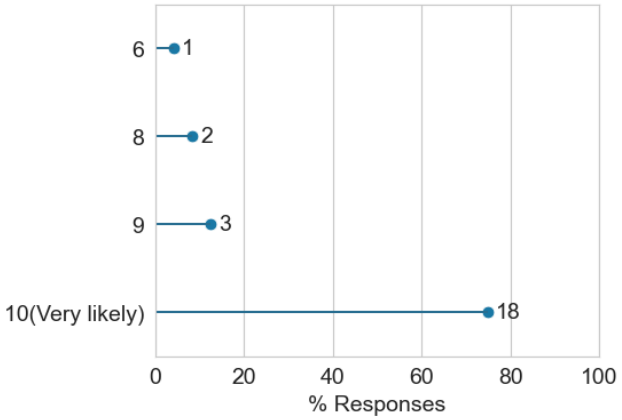

Figure 3: Responses to the question “How likely are you to recommend this workshop to a friend or colleague?” for the second iteration of the workshop “An introduction to high performance computing”.

Feedback from participants was highly favourable. Many noted the instructors’ deep expertise, clear teaching style, and active engagement with questions during the sessions. The atmosphere was consistently described as inclusive and encouraging, contributing to a productive learning experience. Most attendees felt equipped to apply the newly acquired skills and expressed a strong willingness to recommend the workshop to others.

Open and FAIR Principles, Data Management 2.0: Awareness in data management and analysis for industry and research

The second iteration of the workshop was held over 2 days, on March 6th and 7th of 2025. The workshop registration was managed via the CECAM platform, with 38 registrations

received. For the second iteration, the organisation, content and technical tools used remained identical to the first iteration (see the deliverable for the previous iteration for details).

The workshop attracted fewer participants compared to the first iteration, which might be because many institutions are now offering similar workshops. However, it attracted more participants from the BioNT target audience than the previous iteration. There were no significant differences in the delivery experience or the general feedback from participants, which was again largely positive.

	Day 1	**Day 2**
Trainees	27	25
Trainer/helpers	7	7

Table 4: Number of trainees, trainers and helpers per each day of the second iteration of the workshop “Awareness in data management and analysis for industry and research”.

18 workshop participants requested certificates. Certificates will be provided to those who completed the pre- and post-workshop surveys and completed certain hands-on sessions shared with them during the workshop.

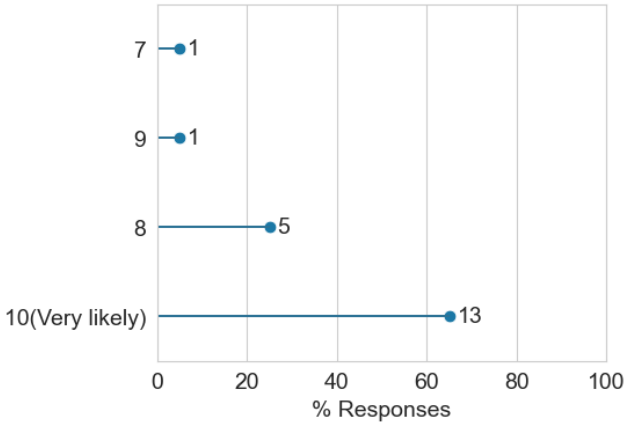

Figure 4: Responses to the question “How likely are you to recommend this workshop to a friend or colleague?” for the second iteration of the workshop “Awareness in data management and analysis for industry and research”.

Participant feedback for this workshop was very positive. Attendees highlighted the instructors' strong subject expertise, clarity in communication, and willingness to engage with questions throughout the sessions. The learning environment was described as welcoming and supportive, and most participants felt confident in applying the knowledge gained. A large majority indicated they would recommend the workshop to others.

Comparative analysis: Rounds 1 and 2 of the basic curriculum

The basic curriculum was first delivered in 2023–2024 (Round 1) and then repeated in 2024–2025 (Round 2). Improvements based on feedback and lessons learned from the first round were discussed earlier in this report. In this section, the comparison of the two interactions is shown, with a focus on participants' country of employment, employment status, and affiliation with SMEs.

As a starting point, the consortium assessed the number of applications received, as well as the employment situation of the trainees: their working location, current employment and relation to SMEs. This was particularly interesting since while for round 1, all applicants were accepted due to sufficient capacity, round 2 introduced selection based on employment in Europe, particularly relevant for the first and second workshops.

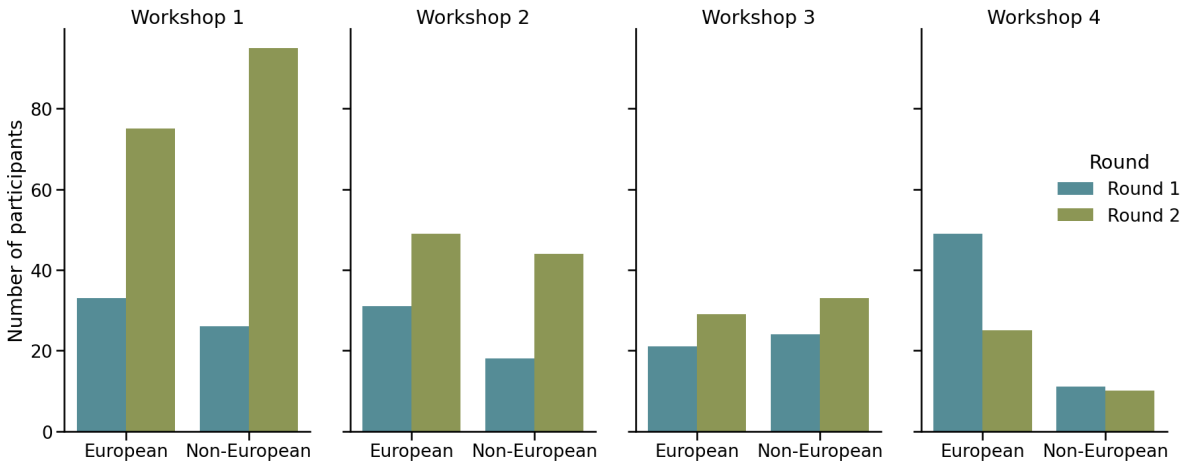

Figure 5: Geographic distribution of applicants by employment location (European vs. non-European countries) across the four basic curriculum workshops. Results are shown for both round 1 (blue) and round 2 (green). Workshops are shown in chronological order: Workshop 1 (Bioinformatics Introduction), Workshop 2 (Introduction to Programming Languages), Workshop 3 (Command Line and Cluster Computing) and Workshop 4 (Open and FAIR Principles, Data Management).

As shown in Figure 5, the geographic distribution of applicants, particularly for the first three workshops, were employed in non-European countries. However, all applicants could be accepted due to sufficient capacity. In round 2, increased visibility and demand led to a higher number of applications, especially for the first two workshops. Because available spots were limited, a selection process was introduced. In these cases, priority was given to applicants employed in European countries, in line with the project's goals and funding priorities.

In the second round of the basic curriculum, more job seekers, including those in the industry, applied for Workshops 1, 3, and 4. For Workshops 1 and 3 in particular, there was also an increase in applications from individuals employed in the industry, as shown in Figure 6. This suggests that the target audience of job seekers was reached more effectively

in the second round of the basic curriculum. Notably, although many applicants identified themselves as job seekers, very few reported being currently unemployed.

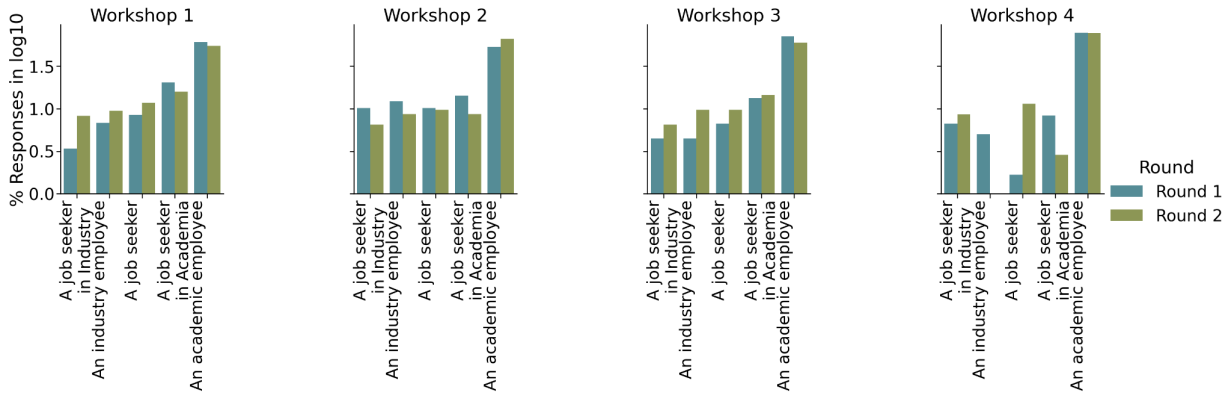

Figure 6: Self-identified applicant roles across the four basic curriculum workshops, shown in chronological order: Workshop 1 (Bioinformatics Introduction), Workshop 2 (Introduction to Programming Languages), Workshop 3 (Command Line and Cluster Computing) and Workshop 4 (Open and FAIR Principles, Data Management). Results are shown for both round 1 (blue) and round 2 (green). Due to the high number of participants that described themselves as “An academic employee” and to better assess other categories, the results are presented on a logarithmic scale.

In response to the reviewer’s feedback on the mid-term report, highlighting the importance of reaching first-time job seekers, the consortium examined self-identified student status across both rounds. Potential first-time job seekers often include graduate and undergraduate students. In the second round of the basic curriculum, there was a notable increase in applications from graduate students across all workshops. Overall, more graduate students than undergraduates applied, suggesting that the workshop topics are particularly well aligned with the needs of students in higher education who are preparing to enter the workforce in the health and biomedical sectors..

	Round	**Workshop 1**	**Workshop 2**	**Workshop 3**	**Workshop 4**	**Total**
Graduate students	Round 1	18	14	10	16	58
	Round 2	65	24	26	14	129
Retired or not employed	Round 1	0	0	0	1	1
	Round 2	6	1	0	1	8
Under-graduate student	Round 1	7	2	4	2	15
	Round 2	10	11	3	0	24

Table 5: Number of applicants who identify as graduate students or undergraduate students comparing the rounds 1 and 2 of the basic curriculum.

Regarding the connections with SMEs, the second round of the basic curriculum attracted more applicants who either worked, collaborated or aimed to work in an SME across all workshops except Workshop 4. This increase was particularly notable in Workshops 1 and 2. However, as each workshop was limited to approximately 60 participants to allow for

focused support, and the primary selection criterion in round 2 prioritised applicants employed in European countries, the difference between rounds was less visible among the final group of participants. The responses provided by the trainees in this regard are shown in Figure 7.

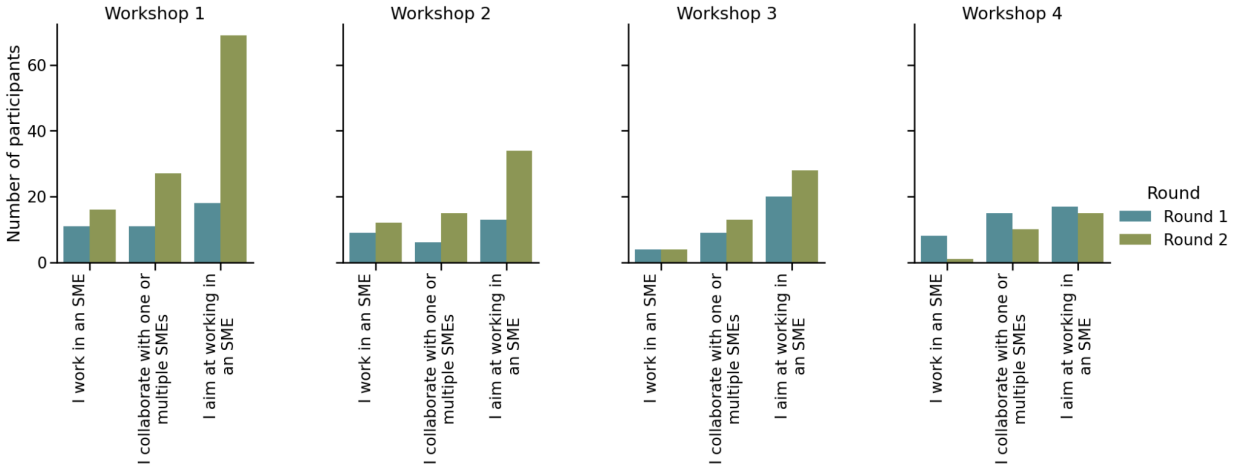

Figure 7: Self-reported connections to SMEs across the four basic curriculum workshops in round 2, shown in chronological order: Workshop 1 (Bioinformatics Introduction), Workshop 2 (Introduction to Programming Languages), Workshop 3 (Command Line and Cluster Computing) and Workshop 4 (Open and FAIR Principles, Data Management). Results are shown for both round 1 (blue) and round 2 (green).

As discussed in previous sections, participant feedback was overall positive. When comparing the likelihood of recommending the workshops to colleagues or friends, the improvements made for the second round of the basic curriculum led to higher recommendation rates for all workshops, as shown in Figure 8.

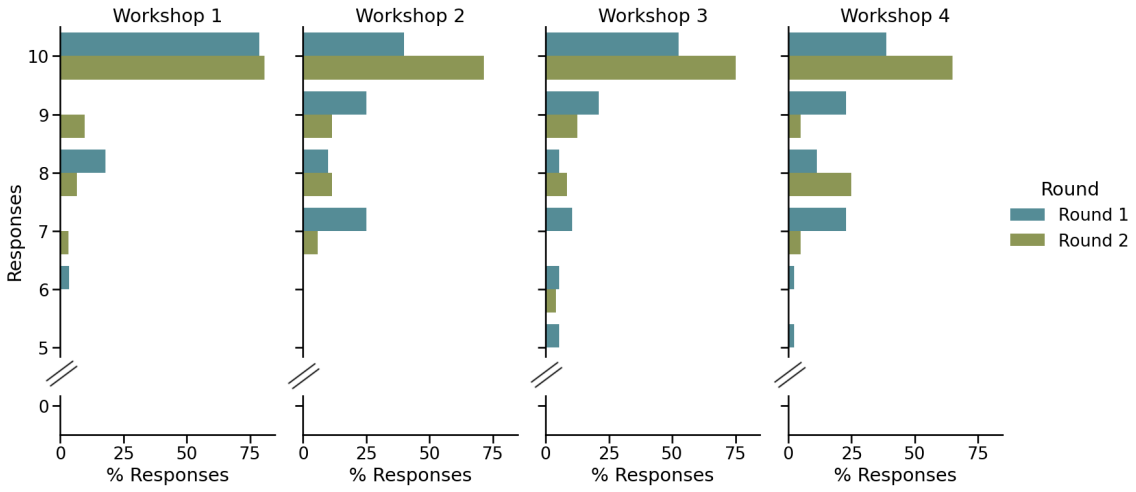

Figure 8. Responses to the question “How likely are you to recommend this workshop?” across the four basic curriculum workshops, shown in chronological order: Workshop 1 (Bioinformatics Introduction), Workshop 2 (Introduction to Programming Languages), Workshop 3 (Command Line

and Cluster Computing) and Workshop 4 (Open and FAIR Principles, Data Management). Results are shown for both round 1 (blue) and round 2 (green).

The comparative analysis indicates that the second round of the BioNT basic curriculum was more effective in reaching its target audience, with an increased number of applicants who were job seekers or had connections to SMEs. Moreover, based on the feedback and Figure 8, it can be concluded that participants perceived the workshops even more positively during the second round.

2.2 Advanced Curriculum

The second year of BioNT introduced the Advanced Curriculum, expanding beyond foundational digital skills to equip data stewards, system administrators, and computational life science professionals with specialized expertise. The curriculum builds upon the first-year training by incorporating advanced computing, software development, and AI-driven data analysis. It consists of four key workshops:

1) Instructor Training: Strategies for Training and Knowledge Exchange with a Consulting Perspective (Completed)
2) Software Best Practices: Code & Collaborate – The FAIRytale of Software Development (Completed)
3) Machine Learning & AI for Biomedical Data (Planned for Q2 2025)
4) System Administration for Life Sciences Computing (Planned for Q4 2025)

Instructor Training: Strategies for Training and Knowledge Exchange with a Consulting Perspective

The first workshop in the Advanced Curriculum, held on June 25th and 26th of 2024, focused on enhancing training methodologies and knowledge exchange in bioinformatics and computational life sciences. It introduced effective instructional techniques, approaches to bioinformatics consulting, and strategies for community engagement and mentoring. The training was fully online and featured interactive discussions and hands-on exercises.

The workshop was well received, with 24 applications and 19 live participants, and 91% of attendees reporting confidence in applying new skills. However, one of the main challenges encountered was balancing interactivity and anonymity. Initially, participants were encouraged to remain anonymous during discussions, but as the workshop progressed, some found this conflicting with later interactive breakout room exercises. This led to hesitation in engagement. To address this in potential future iterations, clearer pre-workshop communication on expectations could be implemented in future sessions, ensuring participants are aware of the interaction format from the beginning.

Additionally, while the workshop provided valuable insights into training and mentoring, some participants felt that the consulting aspects could be explored in greater depth. Future iterations of this workshop could expand on real-world consulting scenarios, offering case studies and practical consulting exercises tailored to bioinformatics professionals. Additional information about this workshop can be found in the deliverable report linked here.

Software Best Practices: Code & Collaborate – The FAIRytale of Software Development

This three-day workshop, held from February 4th to 6th of 2025, introduced participants to collaborative software development practices aligned with FAIR principles (findability, accessibility, interoperability, and reusability). Covering topics such as version control with Git, reproducible research environments, continuous integration, and software documentation, the workshop emphasized hands-on practice and real-world applications.

The workshop had 45 participants attending live, and received highly positive feedback, with 95% of participants stating they would recommend it. The practical approach, particularly the collaborative coding exercises and interactive code reviews, was seen as highly beneficial.

One of the main challenges in this workshop was managing the diverse experience levels of participants. While some attendees were highly proficient in Git and software development, others were relative beginners, which led to varying expectations regarding the workshop's difficulty. To address this, future iterations could introduce pre-workshop self-assessments to help participants gauge whether they meet the prerequisites. Additionally, optional pre-recorded materials could be made available to allow less experienced participants to bridge knowledge gaps before attending.

Another challenge was time management, as some topics required more time than initially planned, particularly discussions around workflow automation and best practices for collaborative development. Future iterations will adjust the session pacing and allocate more time for interactive Q&A and troubleshooting sessions. Additional information about this workshop can be found in the deliverable report linked here.

Machine Learning & AI for Biomedical Data

Building on the success of the first two advanced workshops, BioNT is now preparing for the Machine Learning & AI for Biomedical Data workshop, planned for Q3 2025. This workshop is designed to equip participants with essential skills for processing and analyzing biomedical data using machine learning techniques. The course is structured into two modules:

- Module 1**:** Handling biological data with NumPy and Pandas.
- Module 2: Implementing machine learning and AI techniques on biological datasets

While Module 1 provides the foundational knowledge necessary for Module 2, it remains optional for those who already possess the required skills. Module 2, however, is mandatory for all participants.

To foster industry connections and raise awareness of BioNT's educational offerings, a networking event will be organized ahead of the course. This event will bring together industry experts, startups, trainers, and job seekers from Norway, Eastern Europe, and

Western Europe, offering a platform to explore trends in biomedical data analysis and engage with potential collaborators. The industry event is scheduled for May 7th, 2025.

The course itself will take place over multiple sessions:

- Module 1 will be delivered in two morning sessions
- Module 2 will span six days over two weeks

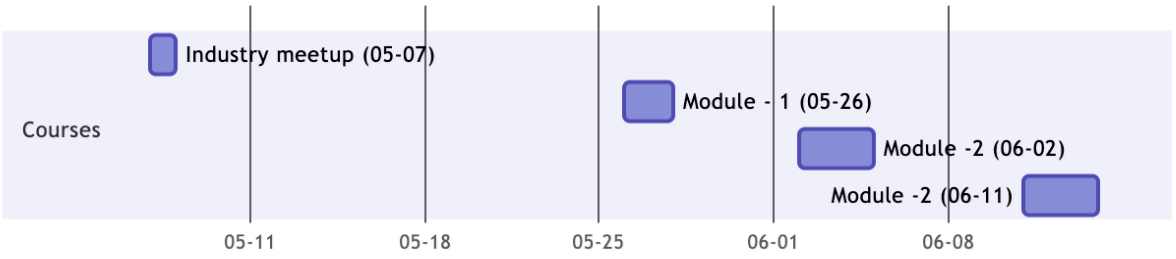

Figure 9: Planned timeline for the course “Machine Learning & AI for Biomedical Data”, including the industry meet-up and the different modular components.

3. Community Building

3.1 BioNT Community Event

The BioNT Community Event, held in collaboration with The Carpentries as part of CarpentryConnect Heidelberg 2024, was a key initiative aimed at strengthening community-led training beyond academia. This event aligned with BioNT's mission to bridge the gap between academia and industry by bringing together trainers, researchers, and professionals from diverse sectors, including academia, SMEs, and the broader life sciences industry.

The event was designed to:

- Facilitate knowledge exchange among European trainers
- Promote cross-sector collaboration, particularly between academia and SMEs
- Support the sustainability of community-driven training programs
- Strengthen synergies within European training initiatives

The event was co-organized with The Carpentries, reinforcing community-driven, open, and collaborative training approaches. The Carpentries' influence was evident through:

- Keynote speakers from The Carpentries and Open Science communities, including Malvika Sharan and Yanina Bellini Saibene, discussed open leadership, mentorship, and measuring community impact
- Training methodology discussions, emphasizing inclusive and hands-on learning approaches that align with The Carpentries' teaching philosophy

- Engagement from The Carpentries community and other well-established training communities, including CodeRefinery and the Galaxy Training Network, in curriculum development and reusable training material workshops

The event featured a hybrid format, hosted at the EMBL in Heidelberg, Germany, allowing both in-person and virtual participation to ensure broad accessibility. The audience included a mix of academics, industry professionals, and SME representatives, fostering discussions on training needs and best practices. The program consisted of:

- Keynote speeches focusing on open science, community building, and industry engagement
- Industry panel discussions on data science skills training for life sciences
- Parallel sessions, lightning talks, and a poster networking session
- Hands-on workshops, mini-hackathons, and curriculum development activities

To promote accessibility, an Inclusivity Ticket initiative was introduced, offering reduced registration fees for participants with financial constraints.

The event played a crucial role in advancing BioNT's objectives by:

- Expanding collaborations with The Carpentries, CodeRefinery, and ELIXIR
- Enhancing the visibility of community-led training initiatives across Europe
- Strengthening engagement between academia and industry, contributing to the evolution of BioNT's training programs

In conclusion, the BioNT Community Event & CarpentryConnect Heidelberg 2024 successfully contributed to BioNT's mission by fostering knowledge exchange, supporting digital skills development, and promoting cross-sector collaborations in biotechnology and biomedical research.

For a comprehensive report on the event, including participation metrics and detailed outcomes, refer to D1.6 Community Event Report. Below, a visual summary of the event, including some photos.

Figure 10: Visual summary of the BioNT Community Event & CarpentryConnect Heidelberg 2024.

3.2 Collaborations and Synergies

BioNT has developed and nurtured strategic partnerships with key organizations across Europe, fostering a collaborative ecosystem that enhances the training initiatives and extends the project's reach beyond the consortium. These synergies have been instrumental in achieving the community-building objectives and creating a sustainable impact in digital skills training for the life sciences sector.

ELIXIR, a European infrastructure for life science information, has been a valuable partner, mostly through its Industry Office. Support from the ELIXIR Industry Days grant enabled the panel discussion at BioNT's community event, bringing together world-class speakers from the industry. This collaboration strengthened BIoNT's connection with ELIXIR's extensive

network, resulting in increased visibility for the training activities and participation from ELIXIR members at the event. The partnership exemplifies how European infrastructures can support targeted training initiatives through resource sharing and community engagement.

As a DIGITAL-funded project, BioNT participates in LEADSx2030, which connects consortia developing advanced digital skills training. Through this network, the consortium has exchanged best practices in short-term course design and delivery with other project leaders, helping to refine the approach to training development and implementation. This cross-project collaboration ensures that BioNT benefits from and contributes to the broader European ecosystem of digital skills initiatives.

BioNT's community-building efforts have been significantly enhanced through the partnership with The Carpentries, culminating in co-hosting the BioNT Community Event and CarpentryConnect Heidelberg 2024. This collaboration extends to the development and translation of training materials, where the project leverages The Carpentries' established community and methodologies while contributing the project's specialized life sciences expertise. Similarly, the work with the Galaxy Training Network (GTN) has created mutual benefits in training material development and translation efforts, allowing both communities to reach broader audiences through shared resources.

BioNT has also engaged directly with the life sciences industry community through targeted outreach activities. The consortium presented a workshop on training opportunities at BioCONTACT, a prominent job fair connecting life sciences graduates with potential employers. Additionally, EMBLEM, the company managing a portfolio of more than 1000 inventions and over 450 patents/copyrights from EMBL-scientists, EMBL-alumni and third parties, published an article about BioNT and the community event, increasing BioNT's visibility among industry stakeholders and potential commercial partners.

These collaborations have significantly enhanced both the training delivery capabilities and the project reach across various sectors. By connecting with established networks and leveraging complementary expertise, BioNT has been able to extend its impact beyond what would be possible as an isolated project. The knowledge exchange facilitated through these partnerships has informed the training methodology, helping to better address the specific needs of the target audiences, particularly job seekers and SME employees. These relationships will provide a foundation for the long-term sustainability of BioNT's training resources and community, ensuring that the digital skills gap in life sciences continues to be addressed beyond the project's formal conclusion.

3.3 Ambassador Program

The BioNT Ambassador Program has gained increasing interest from various community members seeking to engage with BioNT's training and outreach initiatives. While one ambassador has been active in the first year, during the second 10 applications have been received from individuals eager to contribute.

Current role of ambassadors:

- Provide feedback, wishes, and expectations to BioNT
- Communicate upcoming workshops and training opportunities to their communities
- Spread surveys and promote BioNT initiatives within their networks
- Receive training and transfer knowledge back to their communities
- Contribute to knowledge-sharing and the development of digital skills training

Ambassador benefits:

- Participate in the design and structuring of BioNT workshops
- Build connections with stakeholders and collaborators across sectors
- Be featured on BioNT's website, social media, and at community events
- Gain access to exclusive training materials and mentoring sessions
- Obtain a LinkedIn badge recognizing their contributions

To ensure the program aligns with the expectations of potential ambassadors and provides meaningful opportunities for participation, an Ambassador coffee chat session will be hosted on the 7th of April at 10:00 (CEST). This session will allow interested individuals to ask questions, share their motivations for joining, and provide input on how they envision their role within the initiative. The insights gathered will help refine the program structure and ensure that ambassadors receive the necessary support.

Figure 11: Invitation sent to potential BioNT Ambassadors, to join an informative session with the BioNT team.

4. Progress Against Targets and Impact Assessment

4.1 Impact Assessment

Analysing the continuous and future relevance of BioNT's training topics

To confirm the relevance of the BioNT courses for industry, the consortium analysed the existing industry skills reports published in the past 12 months by World Economic Forum (1), EIT Health (2), McKinsey (3), Phenom (4) (global HR technology company, an expert in Talent Experience), AnalytixLab (5) (an Indian SME Data science institute with a large impact in the training field) and the academic publication of meta-analysis of the 9.000 unique job offers in the field of Big Data Analytics, matching words: "big data", "data science", "business intelligence", "data mining", "machine learning" and "data analytics" (6). They all highlight a growing demand for data science skills in biomedical, life sciences, and technology-driven sectors, pointing to industry skill gaps, especially in machine learning, Python, and bioinformatics, which have the strongest demand. HPC and FAIR data/software development seem to be emerging needs for industry. Specifically, the McKinsey report predicts that total working hours in European countries that rely on digital skills will increase by 20%, and by 10-20% for IT and programming skills by 2030. Further, 37% of the jobs analysed by the (6) specifically require following skills Coding, System, Programming, Web, Cloud, Agile, API, Statistics, Model, Data Science, Mathematics, Python, Prediction, Optimization. 6% of the jobs required Machine learning skills.

This alignment shows that the BioNT training program is still highly relevant for SMEs and first-time job seekers looking to bridge the gap between academic knowledge and industry expectations and will be increasingly relevant in the years to come.

References for relevance assessment

1-https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf

2-https://eithealth.eu/wp-content/uploads/2024/08/WorkInHealth-and-EIF-report-Adressing-skills-need-in-European-health-sector-July-2024.pdf

3-https://www.mckinsey.de/~/media/mckinsey/locations/europe%20and%20middle%20east/deutschland/news/presse/2024/2024%20-%2005%20-%2023%20mgi%20genai%20future%20of%20work/mgi%20report_a-new-future-of-work-the-race-to-deploy-ai.pdf

4-https://assets.phenom.com/hubfs/2024%20Phenom_State_of_Skills_2024_Industry_Report.pdf

5-https://www.researchgate.net/publication/354875721_A_Systematic_Review_of_Data_Analytics_Job_Requirements_and_Online-Courses#fullTextFileContent

6-https://www.researchgate.net/publication/354875721_A_Systematic_Review_of_Data_Analytics_Job_Requirements_and_Online-Courses#fullTextFileContent

Impact survey

To evaluate the long-term impact of BioNT's training workshops, an Impact Survey was conducted six months after the training sessions. The survey targeted all BioNT workshop participants, offering them the option to provide multiple responses if they attended more than one session.

The methodology involved:

- Survey distribution: Invitations to complete the survey were sent to all participants of previous training workshops via email approximately six months after said workshop took place
- Questionnaire design: It was designed to capture both quantitative and qualitative insights. Participants were asked about their familiarity with the tools and resources before and after the workshop, providing an indication of skill adoption over time. In addition, the survey explored career development aspects, such as whether the training contributed to securing a job, career transitions, promotions, or increased responsibilities. Respondents also had the opportunity to describe how they applied the skills gained in their professional or academic work, including in research projects, publications, thesis completion, or funding applications. Furthermore, the survey assessed the extent to which participants engaged in new collaborations or expanded their professional networks through the training
- Data collection and analysis: The survey responses were collected anonymously, and they were analyzed to extract trends on skill adoption, employment benefits and community engagement

To complement the email invitation and encourage thoughtful participation, the BioNT team created a short comic-style visual that humorously illustrated the importance of giving feedback after training. The purpose of the comic is to prompt reflection on why feedback matters, both for improving future workshops and for understanding the broader impact of digital skills training. This creative approach was designed to engage participants and lower the threshold for responding.

Figure 12: Comic representation of the impact of impact assessment, internally developed by the BioNT team member Kattyayani Tushar Joag.

The Impact Survey received so far 19 valid responses, reflecting how challenging obtaining long-term feedback is. Analysis of these responses reveals a positive trend in how participants engage with the tools and resources introduced during BioNT workshops. Many reported moving from limited or no prior experience to using the tools more frequently in their professional or academic work. This shift indicates that the training helped participants build practical confidence and integrate new skills into their workflows.

Some participants credited the training with enabling them to develop or publish software, data analysis pipelines, or training materials. Others also reported that the skills gained contributed to the preparation or submission of funding applications, demonstrating the program's value beyond immediate learning objectives.

While none of the current respondents indicated that the training directly led to employment or a career change, the feedback provides strong qualitative evidence of professional development and growing technical independence.

The consortium would like to highlight some of the free-text answers provided by the trainees:

> "*Before the workshop, I didn't know how to perform an RNA analysis using Galaxy. Now I understand how to perform it and, more importantly, to better interpret the results I get*" - Trainee from the first iteration of the workshop "A practical introduction to bioinformatics and RNA-seq using Galaxy"

"*As a PhD graduate in the field of engineering who frequently deals with experimental and simulation data, I needed to learn the principles of research data management*" - Trainee from the first iteration of the workshop “Awareness in Data Management and Analysis for Industry and Research”

"*Thanks to the workshop, I could refresh some knowledge that I knew but almost have forgotten. I also learned new strategies. The workshop helped me to improve the feedback survey in my training. After the workshop I implemented a code of conduct and added a slot with 'housekeeping information' in my workshops"* - Trainee from the workshop “Strategies for Training and Knowledge Exchange with a Consulting Perspective”

"*The concepts learnt were applied to create scripts for data analysis*" - Trainee from the first iteration of the workshop “From zero to hero with Python”

4.2 EC Key Performance Indicators

The KPIs have been periodically updated through the EC portal, with the most recent update provided on January 13th of 2025. In a nutshell:

- 10 training courses have been delivered, 9 of them lasting up to 20 hours and one between 20 and 40 hours
- A total of 511 trainees have enrolled in BioNT’s training courses, with 259 completing them
- From the employed trainees (both accepted and not accepted to participate), 269 described themselves as male, 223 as female and 3 as non-binary

5. Quality Assurance

Building on the experience of the first year and throughout the second year of the BioNT project, a structured quality assurance (QA) process has been developed and refined to ensure the effectiveness and continuous improvement of training activities and project outcomes. This process builds on best practices in education and infrastructural project management and has been shaped by ongoing evaluation and feedback from participants, trainers, and stakeholders.

5.1 Strategic Quality Framework

The BioNT quality assurance framework has been designed with consideration of international quality standards for educational services, ensuring a systematic approach to quality management that addresses leadership, planning, support, operations, evaluation, and continuous improvement.

Leadership and Organization

The project's governance structure provides clear quality oversight through:

- The Executive Board, which ensures the daily activities of the consortium aling with the quality standards established in the project proposal
- The Quality and Ethics Committee (QEC), responsible for monitoring compliance with quality standards
- Work Package leaders, who hold operational responsibility for quality within their domains

Risk Management and Planning

BioNT implements structured planning processes to address potential quality risks:

- Regular risk assessment during consortium meetings
- Documentation of contingency plans for technical and logistical challenges
- Structured change management procedures when adapting training content or delivery methods

5.2 Quality Monitoring and Improvement Cycle

Quality monitoring

Several quality-focused mechanisms have been introduced to monitor and improve BioNT training activities:

- Engagement and completion rates: Participation data is collected (from Zoom) for each workshop to assess attendance. The interactions of participants with the shared notes are also tracked and - because user-specific, although users are anonymous - indicate the level of engagement
- Participants feedback: Surveys before, during, and after each training session help assess content clarity, trainer effectiveness, and overall participant satisfaction
- Trainer and helper feedback: Trainers and support staff are encouraged to provide reflections on session effectiveness, common challenges, and potential refinements.
- Technical and logistical reviews: Each training iteration undergoes an evaluation of technical setup and organizational aspects to enhance future sessions

Quality improvements

The evaluation process has gradually become more structured, integrating key insights from the first year and refining assessment methodologies:

Pre-training adjustments

- Training materials and content structure are reviewed before each session to ensure alignment with evolving project goals and participant expectations
- Past feedback is incorporated into training design, refining session formats and engagement strategies

Real-time adaptation during training

Helpers are the strategic components for real-time responses:

- They provide technical support to address accessibility issues or unforeseen challenges
- They also track participant engagement and suggest questions to tackle or adaptations to the trainers' delivery methods, as needed, to improve learning experiences
- In addition, short real-time surveys (e.g. asking about the delivery pace, font size, etc.) provide information for small adjustments

Post-training reflection and iteration

Survey responses and participation data are analyzed to identify key trends and areas for further development. Lessons learned are documented and shared among trainers to inform upcoming workshops.

5.3 Operational Implementation

Operational Quality Control

The operational delivery of training follows established quality processes:

- Requirements definition: Each training module has clearly defined learning objectives and participant prerequisites
- Design and development controls:
    - Collaborative development with multiple stakeholders providing input
    - Documented review processes before materials were finalized
    - Version control of all training materials
- External resource management: When incorporating external materials (e.g., from The Carpentries or the GTN), quality checks ensure alignment with BioNT standards
- Release controls: Self-learning materials undergo a multi-stage review process before public advertising

Role of the Quality and Ethics Committee

To ensure consistency and ethical considerations in the training program, the Quality and Ethics Committee (QEC) has played a growing role in:

- Reviewing workshop methodologies to ensure fairness, transparency, and accessibility
- Supporting an inclusive and diverse learning environment, aligning with BioNT's broader mission
- Addressing challenges identified through feedback and monitoring, ensuring continuous refinements to the training process
- Conducting periodic internal checks of quality processes

Continuous Improvement

BioNT's commitment to quality extends to continuous improvement through:

- Documentation of lessons learned from each training cycle
- Regular review of quality metrics against established benchmarks
- Proactive request of improvement suggestions from trainers and participants
- Implementation of corrective actions when quality shortfalls are identified

A concrete example of this improvement cycle is evident in the evolution of the workshop delivery format. Based on feedback from the first "Bioinformatics Introduction" workshop, where participants requested more time for hands-on exercises, subsequent workshops were restructured to allocate additional time for practical components, resulting in measurably higher satisfaction scores in post-workshop surveys.

As the BioNT project moves forward, this QA process will continue to evolve, incorporating new insights, adapting to participant needs, and strengthening its role in ensuring high-quality, impactful training experiences.

6. Looking Forward

6.1 Project Adaptations

Throughout the implementation of the BioNT project, the consortium has demonstrated remarkable adaptability in response to emerging challenges and evolving requirements. As with many multi-partner European initiatives, adjustments to the original project plan have been necessary to ensure optimal delivery of objectives and maximum impact. These adaptations reflect both internal organisational developments within the consortium and external factors such as feedback from the European Commission and changing needs of the target audience. The consortium has approached these adaptations with careful planning and strategic thinking, ensuring that any modifications enhance rather than compromise the quality and relevance of the project outcomes.

Change in consortium composition

The BioNT consortium has experienced an organisational change with the closure of Simula Consulting at the end of 2024. To ensure the continuity of project activities and deliverables, the consortium submitted an amendment to include a new partner, RIcapacity, which is currently under evaluation by the European Commission. Despite this formal transition still being in process, the consortium has proactively managed this change by onboarding the new team member from RIcapacity since late 2024. This approach has allowed for knowledge transfer and minimal disruption to project activities. The new partner brings proven expertise in digital skills training and a strong network within the research and innovation community, which the consortium anticipates will strengthen the project's outreach and impact.

Mitigation strategies

In addition to the partner transition, the consortium has implemented several adaptations to enhance project delivery and compliance. Workshop timelines have been adjusted to accommodate the European Commission's requirement for the assessment of trainees six months after course completion. The consortium has also reallocated tasks among existing partners during the transition period to ensure all deliverables remain on schedule. Regular coordination meetings have been intensified to monitor progress closely and address any emerging challenges promptly. These mitigation strategies have proven effective in maintaining the high quality of outputs despite the organisational changes, demonstrating the consortium's resilience and commitment to achieving the project objectives.

6.2 Technical Infrastructure

The BioNT project encompasses numerous interconnected components that require robust technical support systems to ensure seamless implementation. Whilst comprehensive information regarding data management protocols and communication strategies has been previously documented in the Data Management Plan and Dissemination and Communication Plan (both currently undergoing revision), and specific details about training delivery methodologies were thoroughly examined in the first-year report, this section focuses particularly on two critical aspects of BioNT's technical infrastructure: the platform hosting self-paced training materials and the processes facilitating the hosting and translation of these resources. These elements form the foundation of the consortium's commitment to accessibility and sustainability of BioNT's training offers. For additional context and complete documentation, all referenced reports are available on the BioNT website.

Lhumos platform progress

Over the past year, the Lhumos platform has undergone substantial improvements to enhance usability, stability, and access to training content. These updates include a redesigned homepage and map component, improved caching, and new features such as playlist sharing and direct collection links. In parallel, the development of BioNT's self-paced learning materials continued, with Lhumos serving as the main hub for hosting and accessing these resources. Technical updates also ensured better performance and long-term sustainability of the platform. The EPFL team remains committed to the continuous improvement of Lhumos, and BioNT will progressively add more training materials to the platform throughout the project's duration.

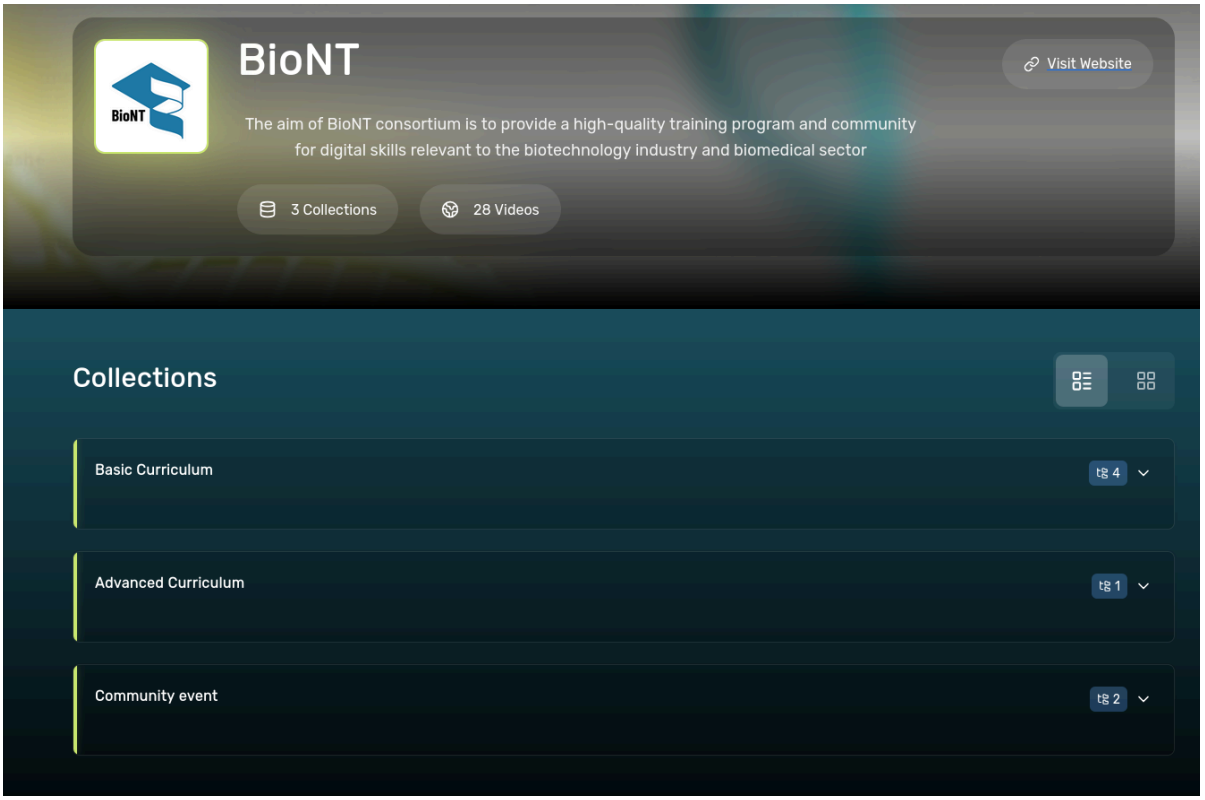

Figure 13: Screenshot of the BioNT space in the Lhumos website, showing the different playlists currently available: Basic Curriculum, Advanced Curriculum and Community Event.

The consortium is currently working on the latest recordings to the Lhumos space, linking to the corresponding training materials for the trainees interest in self-paced learning. Once these materials have reached the established quality criteria, they will be widely advertised to ensure maximum engagement and benefit for the target audiences.

Translation framework and hosting of training materials

BioNT's training materials were developed for self-paced and live delivery using frameworks from The Carpentries (referred to as "Carpentries") and the GTN projects. Each of these frameworks is powered by slightly different flavours of Markdown, a markup language used to facilitate the transformation of the training material into accessible websites. Content is organized into a hierarchy of files and folders for different purposes containing prose, images, callouts, exercises and their solutions. Some files complement the didactic content of the lesson with learning profiles, objectives, outcomes and accessory information for learners and trainers.

The multiple flavors of Markdown, as well as the considerable amount of training material content created and used, has prompted the consortium to develop a tool that would reduce the amount of manual, laborious and time-consuming steps. Harmonising the style and technical scope, this tool also ensures consistency of the content. The approach can be summarily described as:

1. Processing the different flavours of Markdown from each lesson and framework
2. Using the DeepL API to translate content in a context-aware fashion
3. Re-assembling the translated material, re-creating the now-translated Markdown files
4. Validating the translation for technical correctness by rendering it to HTML

While still a proof-of-concept, this framework has now been successfully used to translate the vast majority of the materials from English to German, Spanish and Italian. Revision and curation of the language and content are ongoing. Curated content will be made available on the BioNT portal as soon as revisions are complete and its quality can be ensured.

One of the long-standing obstacles that delayed translation efforts has been the existence of two frameworks from different generations for Carpentries training materials, requiring a duplication of efforts on multiple fronts. One of the lessons from the *An introduction to High Performance Computing* course was particularly challenging as it made use of advanced features of the first-generation template. This obstacle has been recently overcome and now all of the Basic Curriculum is in place and will soon be translated, reviewed and available in the four target languages: English, German, Spanish and Italian.

In addition to the translation of the content, the frameworks themselves needed to support the target languages. This has been the case for Spanish and partially German but not Italian. Where the support was not in place, contributions were made to each project to allow complete translations. German contributions have been integrated and Italian is currently awaiting approval and validation by the corresponding projects.

Similarly, due to the existence of multiple frameworks and the specific needs of the BioNT project, the sustainable hosting of BioNT's training materials and its translations had not yet been clarified. The consortium reports now that a two-fold way forward has been identified. GTN-based materials will be hosted, archived, and maintained as part of the efforts of that project. The Carpentries-based materials will be hosted on the BioNT Training GitHub organisation space. All of the lessons will be linked from the biont-training.eu portal and the Lhumos platform once curated. These approaches ensure that the materials remain available and its sustainability is made possible beyond the lifetime of the BioNT project. At the same time, these guarantee that the content remains synchronized with the live recordings of the Basic Curriculum available on the Lhumos platform.

6.3 Micro-credentials Analysis

Recognizing the value of micro-credentials for learners, BioNT has taken steps to align its training courses with the European Commission's defined requirements. Course materials and structures have been documented accordingly, ensuring that future iterations of the program can meet the necessary standards for micro-credential accreditation.

BioNT courses were carefully planned with defined and relevant learning objectives. Learning objectives were planned considering industry feedback from the industry survey performed at the beginning of the project. All materials included the Code of Conduct and there was a clear procedure for the management of nonconformities, defined in the quality

assurance principles. After each course, feedback from the participants was collected, and reported in individual reports BioNT submitted.

BioNT courses took mostly around 15 hours of training (contact, not self-paced), with one longer exception, which fits the average duration of the micro-credential. All courses were designed so that the learners' progress and participation were trackable.

For all BioNT courses, participants who attended and completed the training (often including proof that they did the exercises) were issued certificates. Formal assessments were not considered at the project proposal stage, and thus BioNT's course closing process was not designed to include it.

EC requirement	Status	Short description
Mandatory elements		
Identification of the learner	🟡 50%, halfway met	For all courses only registered participants were admitted. However, official identification was not performed, also because in conflict with the need for anonymity that was expressed by some.
Title of the course (possible micro-credential)	🟢 100%, fully met	Documented and communicated
Learning outcomes	🟢 100%, fully met	Documented and communicated. Defined using Bloom's taxonomy or comparable. On average, 11 learning outcomes per course are defined.
Notional workload needed to achieve the learning outcomes (in ECTS credits, where possible)	🟢 100%, fully met	Documented and communicated. Most workshops require ~15 hours, but some extend up to 38 hours
Level (and cycle, if applicable) of the learning experience leading to the micro-credential (EQF, QF-EHEA), if applicable	🔵 75%, mostly met	Documented and communicated. All courses informed the participants about the course level (basic curriculum or advanced curriculum), however not using the EQF or similar official framework. Comparing it to the EQF Levels, courses would correspond to the Level 3 (basic course) or Level 5 (advanced course).
Type of assessment	🟠 33%, partially met	In all delivered courses presence or absence of assessment was documented and communicated. Two out of six courses did assessments (33%).
Form of participation in the learning activity	🟢 100%, fully met	Documented and communicated
Type of quality assurance	🟢 100%, fully met	For all courses, an internal review process

used to underpin the micro-credential		by the home organisation was implemented. Trainers were always experienced trainers, most of whom passed the specialized “train the trainer“ programs.
Country(ies)/region(s) of the issuer	🔴 0%, not met	This information was not explicitly included in the certificate, but the organisation issuing the certificate was named.
Awarding body(ies)	🟢 100%, fully met	Certificates were signed by the trainers and carried the project’s and collaborators’ logos
Date of issuing	🟢 100%, fully met	The certificate included the date of issuing and the dates on which the course took place.
Optional elements		
Prerequisites needed to enrol in the learning activity	🟢 100%, fully met	Documented and communicated
Supervision and identity verification during assessment (unsupervised with no identity verification, supervised with no identity verification, supervised, online, or onsite with identity verification)	🟡 50%, halfway met	BioNT courses were supervised with no identity verification. More in detail, access to the courses was only granted from the organisers to the registrants, confirming their identity. However, the trainers and other participants were not aware of their identity during the training. The information about identity verification and supervision was not explicitly provided on the certificates.
Integration/stackability options (stand-alone, independent micro-credential/integrated, stackable towards another credential	🟡 50%, halfway met	All BioNT courses are designed as standalone, but there is no content redundancy between courses, making them stackable. This information was not explicitly communicated on the certificates or on the course materials.
Grade achieved	-	Not applicable as no assessment with grades issued

Table 6: Overview of the alignment of the BioNT courses and issued certificates with the EC requirements for the microcredentials

BioNT courses and the related certificates completely fulfill seven (7) mandatory requirements and partially fulfill five (5). If the consortium was to issue microcredentials, the following improvements would be needed in:

- Documenting the course: Assigning level using one of the officially recognized frameworks, including the country/region in the certificate content, and officially identifying the person attending training. (e.g. checking their ID certificate)

- Assessing the learning performance of the participants: Consistent assessment of the course participants would need to be performed for all the courses

6.4 Future Plans

Upcoming Workshop Schedule

As the consortium enters the final phase of the BioNT project, the remaining workshops in the advanced curriculum include the "Machine Learning of Biological Data" workshop led by University of Oslo in May 2025, featuring preparatory sessions on intermediate Python before specialized machine learning applications, and the "System Administration" workshop led by HPCNow! in October 2025, equipping participants with essential computational infrastructure management skills. This timeline ensures that all planned training activities will be completed while maintaining high-quality standards and incorporating previous feedback.

Dissemination Strategy

The dissemination efforts will build on successful strategies with a renewed focus on reaching SMEs and job seekers. The consortium will continue leveraging LinkedIn, partner websites and relevant network channels (ELIXIR, Bioconductor, LifeSciTrainer, etc.). In particular, the focus will be on promoting courses to the associations of SMEs, especially AI and data focused start-ups and university training offices for first time job seekers. Additionally, EU projects targeting specifically women (EmpoWomen and similar) will be contacted. The machine learning workshop will be promoted to industry on the industry focused event to be held in association with the Norwegian AI cluster. All workshops will be featured on the Digital Skills and Jobs Platform to maximize visibility within the European digital skills ecosystem. Each workshop will be promoted with consistent visuals featuring QR codes for registration, and all materials and recordings will be systematically added to the Lhumos platform, extending the project's impact beyond formal training sessions.

Sustainability planning and resource enhancement framework

In BioNT's final year, the following objectives will be prioritised:

1. **Self-paced training materials**: Converting all workshop materials into modular, standalone units on the Lhumos platform with clear learning objectives, practical exercises, and assessment opportunities
2. **Translation to other languages**: Finalizing translations of basic curriculum materials into Spanish, German, and Italian using the semi-automated workflow of machine translation with expert curation
3. **Enhancing SME involvement in training development:** To strengthen industry relevance, the consortium will:
    a. Organize industry meet-ups for the Machine Learning workshop to gather input on possible relevant datasets and use cases

   b. Implement stakeholder consultation for the System Administration workshop
   c. Participate in relevant events in September 2025 to connect with SMEs
   d. Make targeted efforts to recruit employees from industry partners willing to contribute to the development of training materials and courses
4. **Increasing job seeker participation:** To better reach job seekers, the consortium will:
   a. Collaborate with university career and training services in life sciences programs
   b. Explore partnerships with job-seeking platforms specializing in biotechnology sectors
   c. Leverage European employment services
5. **Trainer/helper certification**: The consortium is in the early stages of developing a certification framework for trainers and helpers, exploring a standardized recognition system that acknowledges contributions, potentially including digital badges that trainers can display on professional profiles