DELIVERABLE 5.3 - THIRD YEAR REPORT

IMPACT ASSESSMENT AND PROJECT REFLECTION

BioNT

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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
ALU-FR	ALBERT-LUDWIGS-UNIVERSITAET FREIBURG
EPFL	ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE

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Project Overview

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.

Preface

The present report serves two purposes: First, it provides a consolidated account of the Key Performance Indicators (KPIs) reported to the European Commission (EC), together with the evidence gathered through the BioNT Impact Survey, the principal instrument through which the consortium tracked medium-term impacts on the participants beyond the point of workshop completion. Second, it offers a reflective assessment of what the project has learned over more than three years of delivery, and of the sustainability arrangements that will carry the project's outputs forward beyond the funding period.

The intended readership encompasses both internal stakeholders: consortium partners, funders, the European Commission, and the wider public, including training communities, potential adopters of BioNT materials, and professionals with an interest in digital skills development for the biotechnology and biomedical sectors.

1. BioNT's Activity Overview

The project delivered two interconnected curricula. The Basic Curriculum covered four foundational areas: bioinformatics and RNA-seq analysis using Galaxy, Python programming, command-line and high-performance computing, and open and FAIR data management principles. Each of the four workshops was delivered twice, allowing iterative improvements between rounds, which spaced between 9 to 12 months. The Advanced Curriculum addressed more specialised topics: instructor training and knowledge exchange, software best practices and FAIR software development, applied machine learning for biological data, and system administration for HPC environments.

To strengthen engagement with industry audiences, the consortium organised two pre-workshop hybrid industry-focused events: an "AI in Biomedical Data: Bridging Innovation and Opportunity" seminar (Oslo, 7 May 2025, 75 participants) and a "Sysadmins in HPC" meetup (Barcelona, 10 October 2025, 60 participants). These events are reported in detail in Deliverable 3.1 - Training Delivery Report.

BioNT also co-organised and chaired the BioNT Community Event alongside CarpentryConnect Heidelberg 2024, bringing together trainers, practitioners, and community members to consolidate the network built during the project. Further details are available in Deliverable 1.6 - Community Event Report.

2. EC Key Performance Indicators: Final status

This section reports the final cumulative KPIs as submitted to the EC via the Funding & Tenders portal. These figures cover the full project duration across all 12 courses delivered. The 12 short-term courses of maximum 22 hours, but averaging 16 hours, comprise the four Basic Curriculum workshops, each delivered in two rounds (8 courses), plus the four Advanced Curriculum workshops (4 courses).

2.1 Training volume

Table 1 shows a summary of the KPIs related to the training volume of BioNT's live training courses in both curricula. Of 655 enrolments across 12 courses, 287 participants met the completion criteria, defined as fulfilling the specific attendance and assessment requirements for each course.

Table 1: KPIs reflecting the training volume of all the online live courses provided by BioNT

KPIs	Value
Number of short-term courses delivered	12
Total enrolments	655
Female enrolments	295
Participants in courses up to 20 hours	553
Participants in courses between 20 and 40 hours	102
Total completions	287

2.2 Participant Employment Profile

Participants were asked to indicate their employment status at the time of registration, and the collected data is shown in Table 2. When collecting gender data, participants could opt

not to provide this data. Accordingly, the total of employed and unemployed/inactive (404 + 177 = 581) is below the total number of enrolments (655):

Table 2: Employment status for the participants who indicated their gender

Employment status	Male	Female	Non-binary	Total
Employed	193	207	4	404
Unemployed or inactive	102	75	0	177

3. Impact assessment

To evaluate the effects of BioNT training beyond immediate workshop delivery, the consortium conducted an Impact Survey targeting all past participants approximately six months after completing each workshop. The survey collected data on tool usage patterns, career and professional development outcomes, and qualitative testimonials documenting how participants applied their training in professional contexts.

This section presents findings across two dimensions. The first covers the employment outcome indicators reported to the EC. The second covers behavioural and societal impact: the changes in how participants used the tools introduced during training, and the professional outcomes they attributed to their participation.

3.1 Survey methodology

The Impact Survey was distributed by email to all BioNT participants who had completed workshops between March 2024 and March 2026, covering both curricula. Participants who attended more than one workshop were invited to submit a separate response for each.

The questionnaire captured both quantitative and qualitative evidence. Participants reported their frequency of tool use before and after the workshop on a five-point scale, indicated which professional outcomes, if any, the training had contributed to, and were invited to describe in free text how they had applied the skills gained.

The survey received 50 responses, representing approximately 7.6% of total enrolments across the project. Responses came from 11 of the 12 course instances, with the highest response counts from the Python workshops (combined 28.0%), the Data Management workshops (combined 18.0%), and the RNA-seq Galaxy workshop (14.0%). The consortium acknowledges that this response rate limits the extent to which findings can be generalised to the full participant population. The qualitative evidence, however, provides substantive insight into the nature and range of the training's impact.

Special emphasis was placed on advertising and reminding the participants to provide feedback. Several reminders were sent via email and a LinkedIn post was made to remind them to check their email and take the opportunity to provide feedback. Additionally, a cartoon, shown in Figure 1, and made especially for this purpose, was included in these communications, to visualise the impact of their feedback.

Figure 1: Cartoon image representing the impact of providing feedback, to encourage participants to answer the Impact Survey

3.2 Impact on employment situation

Employment outcome data were collected through the BioNT Impact Survey, administered to all enrolled participants (KPIs provided in Section 2) approximately six months after workshop completion. Of the 50 respondents:

- 2 participants who were recent graduates found employment after completing training
- 1 participant who was unemployed found employment after completing training

These figures are reported to the EC as part of the mandatory KPI framework and reflect confirmed responses from the Impact Survey cohort (N = 50). They are not extrapolated to the full participant population.

3.3 Behavioural and societal impact

Tool usage and skill adoption

Survey data demonstrate a substantial shift in engagement with the tools and resources introduced during training, summarised below in Table 3.

Table 3: Self-reported usage frequency before and after training

Usage frequency	Before training	After training
Never used (all categories combined)	40% (20/50)	20% (10/50)
Occasionally (monthly or less)	46% (23/50)	46% (23/50)
Frequently (weekly to daily)	14% (7/50)	34% (17/50)

Before attending workshops, 40% of respondents had never used the relevant tools or resources. Following training, this proportion decreased to 20%, a 50% reduction in non-usage. The proportion of participants reporting frequent tool use increased from 14% to 34%, representing a 143% increase. Overall, 80% of respondents (40/50) reported using the tools introduced during their workshop at least occasionally in their professional or academic work following completion.

Professional and career impacts

Participants were asked whether training had contributed to any of a set of professional impacts. Multiple selections were permitted and the results are summarised in Table 4. Cumulatively, 78% of respondents (39 of 50) reported at least one measurable positive professional outcome attributable to their training participation.

Table 4: Self-reported professional outcome after training intervention

Professional outcome	Respondents	Percentage
Work development or publication	21	44%
Career transitioning or employment improvement	15	32%

Funding application or grant preparation	6	14%
Thesis or dissertation submission	5	10%
Job obtained after graduation	2	4%
Useful new collaboration formed	2	4%
Job obtained after unemployment	1	2%

The most frequently cited outcome was the facilitation of work development or publication (44%), indicating that for nearly half of respondents, skills gained directly contributed to research outputs or professional deliverables. Career transitioning or employment improvement was reported by 32%, demonstrating tangible career advancement outcomes. A further 14% reported that training contributed to funding applications, an outcome with implications for the long-term sustainability of participants' professional activities.

Qualitative evidence

The survey collected 28 substantive anonymous testimonials documenting how participants applied their training in practice. Selected examples are presented below, attributed by the corresponding workshop.

> "I got to learn a whole lot more about publishing. I used to work in industry. I did not need to publish in my old position. Now I advise people on it, thanks to your course." - Awareness in Data Management and Analysis for Industry and Research

> "Before the workshop, I did not know how to perform an RNA analysis using Galaxy. Now I understand how to perform it and, more importantly, how to better interpret the results I get." - A Practical Introduction to Bioinformatics and RNA-seq Using Galaxy

> "It helped to automate some of the tasks and therefore improved my productivity." - From Zero to Hero with Python

> "It has given me a better understanding of the tools to use with my own data and how to approach it." - Applied Machine Learning for Biological Data

> "Thanks to the workshop, I could refresh some knowledge that I knew but almost had 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 own

> workshops." - Strategies for Training and Knowledge Exchange with a Consulting Perspective
>
> "I now understand the requirements better and hope it will benefit my career as a Data Steward." - Introduction to High Performance Computing

These testimonials illustrate the range of professional contexts in which participants applied their training: from research publication and workflow automation to career transitions and the improvement of others' training practices.

Survey limitations

The 7.6% response rate means that findings cannot be treated as representative of the full participant cohort. Self-selection bias is likely: participants who derived most benefit from training may be more inclined to respond, which could skew results positively. These limitations do not diminish the value of the evidence gathered but should be considered when interpreting the findings.

4. Cross-cutting reflections: Lessons learned from BioNT

Over three years of delivering digital skills training to an international audience of biotechnology and biomedical professionals, the BioNT consortium accumulated practical knowledge about what works, what does not, and what it takes to run high-quality, open, and sustainable training at European scale. This section distils the most significant lessons, drawing on patterns documented across the full project.

4.1 Reaching the intended audience requires active effort

Openly available training does not automatically reach the audiences most in need of it. The first round of basic curriculum delivery confirmed strong demand from the research community, but reaching the intended target profile (job seekers, SME employees, and industry professionals) required deliberate action in the second round. Enhanced dissemination channels and the introduction of a formal participant selection process, prioritising European applicants who were job seekers or SME-affiliated, were both necessary to convert a globally diverse applicant pool into a participant cohort aligned with the project's objectives. The RNA-seq workshop in round two, for example, received 170 applications for approximately 60 places.

The Advanced Curriculum workshops reinforced this finding. The two industry-focused pre-workshop events (in Oslo and Barcelona) proved highly effective at attracting participants with the right background and motivation. Pre-workshop engagement activities of this kind are recommended for any future training programme with an industry orientation.

4.2 Pedagogical quality improves through structured feedback

One of BioNT's most consistent strengths was the systematic use of feedback at multiple stages: pre-workshop surveys informing instructors of participants' backgrounds, real-time daily feedback during workshops, and post-workshop surveys providing evidence for subsequent iterations. Helpers (supporting participants technically and monitoring engagement) were instrumental in translating this feedback cycle into practice in real time.

Improvements between rounds of the Basic Curriculum illustrate the value concretely: pacing adjustments, clearer prerequisites, refined collaborative document practices for larger cohorts, and co-design elements where participants shaped content based on their interests. The Advanced Curriculum demonstrated that similar quality gains are achievable even within a first delivery, provided that feedback infrastructure is in place from the outset. Recommendation rates across all advanced workshops ranged from 77% to 95% (rating 8–10), with immediate applicability scores between 73% and 91%.

4.3 Infrastructure and translation decisions have long-term consequences

The choice of delivery infrastructure proved consequential. Delivering training via Zoom in webinar format, using HedgeDoc for anonymous participant interaction, aligned well with the project's GDPR obligations and privacy principles, and produced video recordings suitable for public distribution without participant data exposure.

The translation framework, however, required substantially more effort than originally anticipated. Because BioNT's materials were developed across different frameworks (*The Carpentries* and the *Galaxy Training Network*, plus additional content in slides as PDFs), a unified translation approach required bespoke technical solutions for each case. The development of a semi-automated pipeline combining DeepL API translation with expert manual curation was the eventual solution. The lesson for future multi-framework projects is clear: translation infrastructure should be scoped and tested early, not treated as a late-stage task.

4.4 Open collaboration amplifies reach and quality

BioNT's integration within established open training communities, such as *The Carpentries*, the *Galaxy Training Network*, *CodeRefinery*, and *ELIXIR*, was a structural feature of the project from its inception, and its value exceeded initial expectations. These partnerships provided access to established audiences, credibility with target communities, shared materials of proven quality, and a source of external quality assurance that no internal review process could replicate.

The co-organisation and co-chairing of the BioNT Community Event alongside CarpentryConnect Heidelberg 2024 is the clearest expression of this. The joint event brought together participants from multiple countries and communities, generating cross-sector dialogue between academia and industry that is central to BioNT's mission. Further details, including participation figures, are available in Deliverable 1.6 - Community Event Report.

5. Sustainability assessment

Sustainability was a design principle of the BioNT project from its inception. This section provides an assessment of the arrangements in place to ensure that the project's outputs remain accessible and functional beyond the funding period, which concludes in June 2026.

5.1 Training materials

All BioNT training materials are openly licensed and will remain accessible through two principal hosting arrangements determined by the framework in which they were developed.

Materials developed using the Galaxy Training Network framework will be hosted, archived, and maintained as part of GTN's ongoing infrastructure, ensuring they remain synchronised with the evolving GTN ecosystem and discoverable by its large international user community. Materials developed using The Carpentries framework will be permanently hosted on the BioNT Training GitHub organisation space, providing version-controlled, openly accessible hosting independent of BioNT's project infrastructure.

All lessons are linked from the BioNT Training Portal (biont-training.eu/training.html), ensuring unified access. The consortium commits to maintaining these materials for a minimum of five years following the project's end.

VINTSYS, an Oslo-based AI startup, is currently leveraging materials (PDFs, lecture notes, and exercises) from the "BioNT – Applied machine learning with biological data" course to power an intelligent learning assistant. This assistant transforms static training resources into an always-available, interactive learning system. By using Retrieval-Augmented Generation (RAG) with a locally-deployed, open-source large language model (LLM), the platform provides learning experience grounded on source materials ensuring that no data leaves the internal infrastructure. Learners are expected to navigate structured modules, engage with a curated knowledge base to answer questions, and complete gated quiz assessments to progress. As the system prepares for its beta-testing stage, the resulting data is expected to establish a sustainable path for the long-term use of BioNT training materials.

5.2 Translated materials

BioNT has translated its Basic Curriculum materials from English into German, Spanish, and Italian, using a semi-automated pipeline combining the DeepL API for machine translation with expert manual curation for accuracy. Curated translations are progressively made available through the BioNT website as quality assurance processes are completed.

5.3 The BioNT Training Portal

The BioNT Training Portal (biont-training.eu/training.html) serves as the unified access point for all of the project's self-paced learning resources. For each of the 12 courses delivered, the portal provides links to the written training materials and to the video recordings hosted on the Lhumos platform (https://lhumos.org/spaces/biont), developed and maintained by EPFL. Lhumos organises recordings into thematic playlists corresponding to the Basic Curriculum, Advanced Curriculum, and Community Event, linked directly to the corresponding written materials. EPFL's ongoing hosting commitment ensures these video resources remain available to independent learners beyond the project period. The portal also provides a self-assessment checklist for anyone to check course's alignment with the European Council's micro-credentials requirements. The consortium's experiences and lessons learned in designing online and self-paced learning formats are documented separately as part of Task 7.6 (Müller & Müller, 2026; https://zenodo.org/records/19334986), intended to enable other training communities to benefit from these insights beyond the BioNT context.

5.4 Community continuation

The relationships built through the project, with *The Carpentries, the Galaxy Training Network, CodeRefinery, ELIXIR*, and industry partners, represent the community infrastructure that BioNT has developed alongside its materials. These connections extend the project's reach well beyond the nine consortium partners and provide the basis for continued uptake and adaptation of BioNT's training resources by others.

No follow-on funded project is planned. The project's legacy rests on the open availability of its materials, the trained instructors and helpers who participated in the project, and the community of practice cultivated over three years.

6. Conclusion

The BioNT project set out to address a documented gap in the availability of targeted, open, and sustainable digital skills training for Europe's biotechnology and biomedical workforce. Across three years, 12 courses, and 655 enrolments, the consortium delivered training spanning foundational and advanced digital competencies, developed an openly licensed curriculum, and built a network of trainers, helpers, and community members extending well beyond the nine partner organisations.

The Impact Survey evidence confirms that a significant proportion of participants experienced lasting change: 78% of respondents reported at least one measurable positive professional outcome, and the proportion of frequent tool users increased by 143% following training. The qualitative testimonials illustrate the human dimension of these findings: careers advanced, publications enabled, new skills integrated into daily practice.

The cross-cutting reflections in Section 4 distil three years of practical learning on audience targeting, pedagogical iteration, infrastructure decisions, and the value of open collaboration. The sustainability arrangements described in Section 5 ensure that BioNT's materials will remain accessible for a minimum of five years beyond June 2026, continuing to serve learners, trainers, and institutions across Europe.

The BioNT consortium thanks the European Commission for its support through the Digital Europe Programme, all consortium partners for their contributions across three years of collaboration, and the participants whose engagement, feedback, and testimonials have made it possible to assess and communicate the value of this work.