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Novel Biotechnological Solutions in Climate Change Mitigation

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PILOT TRAINING REPORT

BIOSHIELD PILOT COURSES

1. General Information

Partner Institution	CANAKKALE ONSEKİZ MART UNIVERSITY
Department/Faculty	*Molecular Biology and Genetics*
Country	*Turkiye*
Work Package	*WP4 — Pilot Course*
Date of Report Submission	30 September 2026
Pilot Training Dates	*16 February-05 June 2026*
Responsible Person(s)	*Kemal Melih TASKIN*
Associated Partner(s) Involved	Çanakkale Commodity Exchange; Glycogest Biotechnology
Target Number of Participants	*20*
Actual Number of Participants	*58*

2. Overview of the Pilot Training

Provide a concise narrative (max. 1-2 pages) describing how the pilot training was organised and delivered at your institution. This narrative should give readers who were not present a clear understanding of what took place. Please address the points below.

2.1 Organisation and Preparation

The BIOSHIELD pilot course at Çanakkale Onsekiz Mart University (ÇOMÜ) was hosted by the Department of Molecular Biology and Genetics and delivered over the full 2025–2026 spring semester, from 16 February to 5 June 2026. The pilot was coordinated by Prof. Dr. Kemal Melih Taşkın as the responsible person for WP4 at ÇOMÜ, supported by three further academic staff members of the project team; in total, four academic staff members of the department acted as trainers and facilitators of the working groups.

Students were recruited through an open call announced within the Department of Molecular Biology and Genetics and through the regular course registration process. Interest in the course considerably exceeded expectations: against a target of 20 participants defined in the project application, 58 students enrolled and took part in the pilot. Since the department had the staff and laboratory capacity to accommodate them, all interested students were admitted and the organisation of the working groups and laboratory sessions was scaled up accordingly.

The pilot was built on the common BIOSHIELD training model shared by all partner institutions. The BIOSHIELD curriculum defined the sequence and content of the modules, the animated video tutorials were assigned as preparatory material before the face-to-face sessions, and the "Biotech Student's Guide to Future Projections" handbook was used as the reference text for the biotechnology application and entrepreneurship components. The weekly schedule was aligned with the academic calendar so that preparatory (online) work, in-class sessions and laboratory work alternated throughout the semester. The associated partners of ÇOMÜ in the project, Çanakkale Commodity Exchange and Glycogest Biotechnology, were involved as the industry and sector interface of the pilot: the working groups contacted sector representatives while exploring and defining their challenges, and representatives provided feedback on the groups' problem definitions and solution concepts.

2.2 Methodology and Learning Activities

The course followed the flipped/blended learning approach foreseen in the BIOSHIELD methodology. Before each in-class session, students studied the relevant animated video tutorial and the corresponding handbook chapter; contact hours were then devoted to discussion, problem solving and practical work rather than to lecturing. Short introductory lectures were used only to frame the climate-change-mitigation challenges addressed by each module.

The core of the pilot was the Design Thinking process (Empathize, Define, Ideate, Prototype, Test). Working in small groups, students first explored real industrial and environmental problems related to climate change mitigation (Empathize), formulated a precise problem statement (Define), generated and screened alternative biotechnological solutions (Ideate), developed a research project concept outlining a possible solution and the steps needed to realise it (Prototype) and finally tested and refined the concept through preliminary hands-on laboratory work, peer discussion and expert feedback (Test). Given the one-semester duration of the pilot, the Prototype and Test phases focused on developing and validating well-grounded research project ideas rather than on building physical prototypes.

Learning activities therefore combined: (i) flipped-classroom preparation with the video tutorials and the handbook; (ii) in-class workshops and group work; (iii) hands-on laboratory sessions in the research laboratories of the Department of Molecular Biology and Genetics; (iv) use of digital tools for collaboration, documentation and presentation; and (v) interaction with academic experts and with sector representatives, including the associated partners, who commented on the groups' problem definitions and solution concepts. The pilot concluded with final group presentations in which each team presented its research project idea.

2.3 Participant Profile

All 58 participants were undergraduate students of the Molecular Biology and Genetics programme of ÇOMÜ, in their fourth (final) year of study. Participants had completed the fundamental courses in molecular biology, genetics, biochemistry and microbiology and therefore had the basic laboratory skills required for the hands-on component; most had no prior experience with Design Thinking or with structured, challenge-based project work, which the pilot specifically aimed to develop.

Students were organised into 13 working groups of 4–5 members each. Groups were self-selected by the students on the basis of shared interests; each group selected its own climate-change-related biotechnology challenge and kept the same composition throughout the Design Thinking cycle.

2.4 Additional Organisational Information

The pilot made use of the classrooms and the teaching and research laboratories of the Department of Molecular Biology and Genetics. The four academic staff members of the project team supported the groups throughout the semester, acting as facilitators during the ideation phase and as supervisors during the laboratory testing phase.

No deviation from the planned BIOSHIELD methodology was necessary. The number of participants (58) was almost three times the target (20); as the department had the capacity to host all interested students, this was treated as an opportunity rather than a problem, and the number of working groups and laboratory slots was increased accordingly. The associated partners, Çanakkale Commodity Exchange and Glycogest Biotechnology, supported the pilot as the link between the student groups and the sector.

In addition to the standard post-training satisfaction questionnaire, the ÇOMÜ team carried out individual face-to-face interviews with participating students after the pilot; the interview transcripts were kept as complementary qualitative evidence of the pilot.

3. Pilot Training Indicators

The table below shows the quantitative results of the pilot training implemented at your institution. These indicators correspond to the quantitative (QN) indicators for WP4-O4 defined in the project application.

Indicator	Reported Value
Number of students participating in the pilot training	58
Number of students completing the satisfaction survey	39
Number of working groups formed	13
Number of research ideas and/or prototypes developed by the groups	13 research ideas
Number of students successfully completing the pilot training	58
Number of students receiving certificates	58
Overall attendance rate	≥ 70 % (all participants)
Completion rate	100 %
Number of academicians confirming effectiveness of course delivery methodology	4
Number of industry representatives confirming effectiveness of course delivery methodology	2
Number of student video testimonials collected	5

4. Satisfaction Survey Results

The table below reports the aggregated results of the post-training satisfaction survey administered to pilot participants, using a five-point Likert scale (1 = Strongly Disagree, 2= Disagree, 3= Neither Agree Nor Disagree, 4= Agree, 5 = Strongly Agree).

No	Survey Statement (5-point Likert Scale: 1 = Strongly Disagree, 5 = Strongly Agree)	1	2	3	4	5	4+5
1	I am highly satisfied with the overall quality and delivery of the BIOSHIELD training program.	0%	0%	2.6%	0%	97.4%	97.4%
2	The program effectively improved my transversal skills, such as teamwork, communication, and creative problem-solving.	0%	2.6%	0%	10.3%	87.2%	97.4%
3	I feel that my research skills in biotechnology (particularly related to climate change mitigation) have significantly improved.	0%	2.6%	2.6%	17.9%	76.9%	94.9%
4	I feel better prepared to enter the labour market as a result of this training.	0%	2.6%	2.6%	20.5%	74.4%	94.9%
5	The animated video tutorials effectively helped me understand the key concepts and prepare for hands-on activities.	0%	2.6%	5.1%	20.5%	71.8%	92.3%
6	The Design Thinking process enhanced my ability to generate innovative solutions to industrial challenges.	0%	2.6%	0%	10.3%	87.2%	97.4%
7	The “Biotech Student’s Guide to Future Projections” handbook provided valuable guidance on biotechnology applications and entrepreneurship.	0%	2.6%	0%	17.9%	79.5%	97.4%
8	The use of digital tools and interactive technologies enhanced my learning experience.	0%	2.6%	5.1%	5.1%	87.2%	92.3%
9	Hands-on laboratory activities were essential for testing and refining our biotechnology research ideas.	0%	2.6%	5.1%	17.9%	74.4%	92.3%
10	My team successfully developed a functional prototype or research project concept during the pilot training.	0%	2.6%	10.3%	5.1%	82.1%	87.2%
11	Interactions with industry representatives and academic experts helped me better understand real-world industrial challenges.	0%	0%	2.6%	15.4%	82.1%	97.4%
12	I intend to pursue a career in the biotechnology industry.	0%	0%	7.7%	20.5%	71.8%	92.3%
13	I have a strong intention to establish or join a biotechnology startup in the future.	0%	2.6%	0%	7.7%	89.7%	97.4%

n = 39 respondents (67.2 % of the 58 participants). Percentages are rounded to one decimal; "4+5" is the share of respondents who agreed or strongly agreed. Mean scores (1–5) ranged from 4.62 (item 5) to 4.95 (item 1), with an overall mean of 4.74 across the 13 items.

5. Analysis of Survey Results

This section interprets the survey findings reported in Section 4 and discuss the pilot training's contribution to the project's objectives. Please address the following points.

5.1 Overall Participant Satisfaction

Overall satisfaction with the ÇOMÜ pilot was very high. Of the 39 students who completed the questionnaire, 97.4 % agreed or strongly agreed that they were highly satisfied with the overall quality and delivery of the BIOSHIELD training programme (item 1; mean 4.95), and the single remaining respondent was neutral. No participant selected "strongly disagree" for any of the 13 statements, and the only "disagree" answers (2.6 %, one respondent) came from the same student, who rated most items at 2 or 3 while still agreeing with the entrepreneurial-intention statement.

Agreement (4+5) was above 92 % for twelve of the thirteen items and above 97 % for six of them (items 1, 2, 6, 7, 11 and 13). The lowest agreement level was still 87.2 % (item 10, prototype / research idea developed by the team). Taken together with the consistently high means (4.62–4.95), the results indicate that the pilot was received very positively by the participants and that the common BIOSHIELD delivery model worked well in the ÇOMÜ context despite the much larger-than-planned group size.

5.2 Strengths and Weakneses

Strengths. The items with the highest means point to the elements students valued most: the overall quality of delivery (item 1, 4.95), the development of transversal skills such as teamwork, communication and creative problem solving (item 2, 4.82), the Design Thinking process as a tool for generating innovative solutions (item 6, 4.82), the interaction with academic experts and industry representatives (item 11, 4.79) and the use of digital tools and interactive technologies (item 8, 4.77). The handbook was also rated highly (item 7, 4.74; 97.4 % agreement), confirming its usefulness as a reference for biotechnology applications and entrepreneurship.

Weaknesses / areas for attention. Given the consistently positive results and the small share of non-positive answers (at most 10.3 % neutral on any item), no genuine weakness emerges from the survey. The only items where agreement dropped slightly below the others were item 10 (team outcome of the Design Thinking cycle; 87.2 % agreement, 10.3 % neutral) and items 5, 9 and 12 (video tutorials, hands-on laboratory work and career intention; 92.3 % agreement each). These differences are small and point to areas for fine-tuning rather than to problems in the design or delivery of the pilot.

5.3 Learning Outcomes

The survey provides clear evidence of the learning outcomes targeted by WP4. In terms of transversal skills, 97.4 % of respondents (mean 4.82) agreed that the programme improved their teamwork, communication and creative problem-solving abilities (item 2); this is one of the strongest results of the pilot and is consistent with the group-based Design Thinking format of the course.

Research skills in biotechnology for climate change mitigation (item 3) were considered significantly improved by 94.9 % of respondents (mean 4.69), and 94.9 % felt better prepared to enter the labour market as a result of the training (item 4; mean 4.67). Both items show a large majority of "strongly agree" answers (76.9 % and 74.4 %, respectively), indicating that students perceived a substantial, not merely marginal, gain in competence and employability.

Career and entrepreneurship intentions were also high. 92.3 % of respondents intend to pursue a career in the biotechnology industry (item 12; mean 4.64) and 97.4 % expressed a strong intention to establish or join a biotechnology start-up in the future (item 13; mean 4.85, with 89.7 % strongly agreeing). It is notable that entrepreneurial intention scored higher than general career intention, which suggests that the entrepreneurship components of the course – the handbook, the Design Thinking cycle and the exposure to real industrial challenges – were effective in raising students' interest in creating or joining biotechnology ventures.

5.4 Achievement of Project Objectives

The results support the achievement of the WP4-O4 objectives and expected results at ÇOMÜ:

- **Effectiveness of the course delivery methodology.** The flipped/blended learning approach combined with Design Thinking was confirmed by the participants: 97.4 % agreed that Design Thinking enhanced their ability to generate innovative solutions (item 6) and 92.3 % that digital and interactive tools enriched their learning experience (item 8). The four academicians and the sector representatives of the associated partners involved in the pilot confirmed the effectiveness of the methodology (see Section 3).
- **Research ideas / prototypes developed.** All 13 working groups completed the Design Thinking cycle and each produced a research project idea addressing a climate-change-mitigation challenge, giving 13 research ideas in total. In line with the one-semester format, the groups focused on developing and validating these ideas rather than on building physical prototypes; 87.2 % of the students nevertheless stated that their team successfully developed a research project idea (item 10). Descriptions of the ideas are provided in Annex 6.
- **Participation and certification.** With 58 participants against a target of 20, the quantitative participation target was exceeded by a factor of almost three. All 58 participants met the attendance requirement of the course (≥ 70 %), successfully completed the pilot and received certificates (completion rate 100 %).
- **Effectiveness of the BIOSHIELD curriculum, video tutorials and handbook.** The curriculum-based course was rated as highly satisfactory overall (item 1, 97.4 %); the animated video tutorials were considered effective in understanding key concepts and preparing for hands-on activities by 92.3 % of respondents (item 5), and the handbook was found to provide valuable guidance by 97.4 % (item 7). These figures provide direct evidence for the quality and usability of the project's intellectual outputs.
- **Employability and entrepreneurship.** As discussed in Section 5.3, the high agreement on items 4, 12 and 13 shows that the pilot contributed to the project's broader objective of preparing biotechnology students for the labour market and for entrepreneurial activity in climate change mitigation.

5.5 Recommendations for Improvement

Based on the survey results and the experience of the ÇOMÜ team, the following suggestions are made for future editions of the BIOSHIELD course:

Fine-tune the elements with slightly lower ratings. The video tutorials (item 5) and laboratory sessions (item 9) were appreciated but rated marginally below the interactive, group-based elements. Linking each tutorial to a short pre-class task and scheduling laboratory work closer to the corresponding Design Thinking phase would strengthen their perceived contribution.

Keep the group-based format and sector interaction. These were the highest-rated components and should remain central to the course; where possible, contact with sector representatives could be formalised through structured mentoring of each group.

Manage cohort size. The enrollment of 58 students against a target of 20 shows strong demand. Future editions should scale facilitators and laboratory slots with the number of participants so that groups can be kept at 4–5 members.

Provide career-oriented follow-up. The small share of neutral answers on item 12 suggests that some students would benefit from additional information on concrete career pathways in the biotechnology sector, complementing the strong entrepreneurial interest expressed in item 13.

6. Annexes

Please list and attach any supporting documentation referenced in this report.

Annex	Description	Uploaded (Y/N)
Annex 1	List of participating students	Y
Annex 2	Certificates issued (sample)	Y
Annex 3	Raw satisfaction survey data (Google Forms/Excel Sheet)	Y
Annex 4	Photographic documentation / activity evidence	Y
Annex 5	Student video testimonials (.mp4 or video file reference)	Y
Annex 6	Description(s) of research ideas / prototypes developed (Student Presentations)	Y
Annex 7	Other supporting documents (if applicable)	N/A