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Summer Schools

for STEM CPD Ambassadors

Handbook for organisers

http://ectn.eu/work-groups/stem-cpd/

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1. Introduction

This handbook is intended for those interested in implementing, enhancing, and expanding Continuous Professional Development (CPD) in teaching and learning within higher education.[1] It offers practical guidance on organizing summer school-type training for lecturers, referred to as CPD Ambassadors, aiming to promote CPD in their universities. While this guide has been initially developed for STEM (Science-Technology-Engineering-Mathematics) faculties and primarily tested with chemistry lecturers, it can be adapted for use in other disciplines.

The CPD Summer Schools provide a wide range of learning opportunities for participants and their institutions, not only to enhance education quality within their disciplines but also to improve overall teaching and learning practices.

Within this handbook, the objectives and philosophy of CPD Summer Schools, along with their intended learning outcomes are described. Concrete examples from the STEM-CPD Summer Schools developed and conducted in our project are also included. The handbook encompasses the program details of the two STEM-CPD Summer Schools held in 2021 and 2022 as part of the STEM-CPD@EUni project. Additionally, descriptions and designs of the activities used to facilitate learning and promote co-creation, strategies and methods for monitoring learning and assessment, and outlines the design of the CPD Ambassador certificate are given.

2. Aim and philosophy of the Summer School

The aim of the CPD Summer School is to develop university teaching competences in an international dimension, enabling the participants to implement professional development activities that increase the quality of teaching and learning at their respective universities. In addition, participants in the CPD Summer Schools are given the opportunity to join the international CPD Ambassador Community.

Our unique European Summer School format is based on the STEM-CPD framework – "*The Summer Schools develop the CPD-Ambassadors in three dimensions: competencies, attitudes and use of different types of CPD activities. The content of the Summer School is determined by the needs of the CPD-Ambassadors. The course design of the Summer Schools is based on Constructive Alignment (Biggs and Tang, 2011), using co-creation activities and community of inquiry approach. The Summer Schools have in several aspects a flipped classroom approach. The participants have to prepare for the event in advance and need to submit a proposal about their user case to be allowed to follow the Summer School*" (STEM-CPD Framework, 2021).

The central element of this framework is the CPD-Ambassador. We assume that the development of competences necessary for CPD-Ambassador activities should commence with a Summer School.

[1] That is, the development of competences necessary to perform the role of an academic teacher by people already working in such a position. In the further part of the document, we will use the terms lecturer and academic teacher interchangeably to mean any person who teaches students (lecturer, senior lecturer, professor, teaching assistant, etc.)

Attendees of this Summer School will return to their respective home universities to organize STEM-CPD activities among their peers. Participants from different countries will share their experiences in the field within a European and international context. This is particularly crucial due to the existence of the common European Higher Education Area (EHEA) on the one hand, and the significant disparities in CPD levels and scope among individual countries on the other. However, it is also possible to organize such a school at a national or regional level.
The format of the CPD Summer schools enables an autocatalytic cascade process, where today's learners will become tomorrow's teachers, promoting a constant and sustainable effort to enhance teaching skills. The CPD-Ambassadors will instigate change within their local organizations by implementing various scenarios and methodologies acquired at the CPD Summer Schools. This, in turn, will result in the enhancement of the teaching skills of the local staff and an improvement in the quality of BSc and MSc level courses at their institutions, ultimately leading to a positive impact on the learning outcomes of the participating students.

During the Summer School, CPD-Ambassadors acquire knowledge, receive relevant materials, and create their own resources to facilitate CPD activities at their home universities, known as "User Cases." They maintain contact with the Summer School staff and their peers, receiving feedback. This way, the CPD Summer School participants establish a lasting community of practice that extends beyond the event.
In STEM-CPD Summer schools, we explore strategies to incentivize excellence in university STEM teaching, such as evidence-based course design through educational action research practices. However, it's worth noting that these types of schools can also promote strategies to incentivize excellence in teaching and learning across various disciplines.

In particular, the value of this approach can be envisaged in:

- Establishing an international network to connect and maintain connections within a continually growing community dedicated to CPD. This network facilitates the exchange of knowledge and experiences related to pedagogical content knowledge.
- Continuously enhancing teaching practices by gaining an understanding of evidence-informed teaching based on scientific literature, thus promoting the implementation of such practices.
- Developing a solid grasp of pedagogical content knowledge and teaching skills, which encourages a more student-centered teaching approach and fosters a greater sense of self-efficacy as a teacher.

3. Participants

The CPD Summer school is designed for university teaching staff in any position involved in teaching and learning. Specifically, the STEM-CPD Summer School is targeted at STEM lecturers seeking to critically examine, update, and enhance teaching and learning methodologies at their universities through the organization of STEM-CPD activities. The CPD Summer School is closely aligned with the teaching practices of each participant, following the workplace learning principle. It is also founded on the co-creation principle, meaning that participants will not only receive relevant materials for their development as CPD-Ambassadors but will also generate their own materials to facilitate and expand their CPD activities. Since the Summer School employs a workshop-based approach, its outcomes are contingent on the contributions and engagement of the participants. Their learning experience extends not only from interactions with the school staff but also from their peers, and this aspect should be acknowledged from the outset of the application process.

The total number of participants for a single CPD Summer School can vary, but it should be tailored to accommodate the working conditions and the teaching and learning methods that rely on participant engagement, discussion, and collaborative work in small groups. To ensure the effectiveness of the proposed activities and to encourage active participation from each student, we recommend that the number of participants does not exceed 25 people. Additionally, hybrid or online CPD Summer Schools are feasible when there is adequate digital technology available to support these methods.

4. List of intended learning outcomes of the CPD Summer School

The CPD Summer School aims to foster a student-centered teaching approach, promote active learning practices, and encourage person-centered Continuous Personal Development in teaching and learning. It also seeks to facilitate sustainable cooperation through the CPD-Ambassador community. These objectives have been translated into specific intended learning outcomes for the STEM-CPD Summer School, following the recommendations outlined in the STEM-CPD@EUni project's Roadmap (2021).

The intended learning outcomes of the STEM-CPD Summer School are as follows:

1. **Organize Local CPD Activities:** Participants will learn to define challenges for their own user case, design a CPD scenario, utilize a blended learning approach (combining online educational materials with classroom-based teaching and learning methods), and analyze the limitations and advantages of various CPD activities.
2. **Promote Learner-Centered Learning:**[2] Attendees will focus on fostering learner autonomy and independence, emphasizing skills and attitudes that facilitate lifelong learning and problem-solving.

[2] Learner-centered education puts learners' interests first: learners choose what they will learn, how the learners will learn, and how the learners will express their achievement of learning outcomes

3. **Apply Constructive Alignment:** [3] Participants will be able to select STEM teaching and learning methods aligned with intended learning outcomes and choose appropriate evaluation methods and techniques, which they will then apply in CPD activities.
4. **Apply TPACK (Technological Pedagogical Content Knowledge):** Attendees will gain the ability to design learning activities for flipped classrooms and ensure active learning in face-to-face, online, or blended settings. They will also incorporate active learning elements into μMOOCs.
5. **Support Three Dimensions of STEM-CPD:** Participants will work towards the development of teaching competences, teaching attitudes, and CPD activities.
6. **Stimulate and Enable Sustainable Cooperation:** Students will learn how to promote and facilitate cooperation effectively within the CPD-Ambassador community. They will understand the role of a CPD-Ambassador, justify the importance of collaboration in education and CPD programs, and create conducive conditions for such cooperation.

These intended learning outcomes reflect the comprehensive goals of the STEM-CPD Summer School, aiming to equip participants with the knowledge, skills, and attitudes necessary for enhancing teaching and learning in STEM disciplines while fostering a collaborative and sustainable educational community.

The TPACK model emphasizes that teaching is most effective when there is an integrated application of content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) (Mishra and Koehler, 2003). Based on the TPACK methodology, teaching and learning events within a course, whether with students or in the CPD Summer School, offer an effective approach to delivering and acquiring knowledge that relies on the seamless integration of digital technologies. This integration can occur before, during, and/or after classroom sessions. The CPD Summer School not only benefits but also inspires participants through the innovative teaching and learning methods and pedagogical approaches they themselves experience.

5. Instructional design of the activities of the CPD Summer School

The instructional design of the learning activities in the CPD Summer School is based on an active learning and co-creation approach and offer interactive workshops, training sessions, collaborative groups, and ample opportunities for discussion.

1) Workshops are made up of interactive activities guided by a session coordinator. These focus on methods and tools used in higher education teaching and learning, as well as on how to organize professional development for academic teaching staff. The goal is to develop skills for using specific

[3] Constructive alignment requires from a course a design in which intended learning outcomes, learning activities and assessment are aligned with each other (Biggs, 2011).

educational tools in everyday teaching practice and to generate ideas for organizing education/training (CPD) for fellow lecturers. For example:

- How to use research findings to design student-centered activities.
- How to promote the use of innovative tools (by STEM teachers) that support active learning, critical thinking, and deep understanding, or facilitate mastery learning.
- Organizing meetings with guest presenters who demonstrate the use of specific digital tools (e.g., tools for pre-lecture or laboratory session preparation, self-paced knowledge gap bridging).
- How to design CPD activities based on the TPACK model.

2) Group work consists of sessions during which participants discuss and refine their proposals for improvements to be implemented in their teaching practice. These sessions are moderated by facilitators who organize the group work, facilitate peer feedback among participants and between groups and offer suggestions and guidance for the design of the proposals.
The group work activities primarily focus on:

- Collaboration and co-creation.
- Designing and developing CPD User cases.
- Sharing best practices related to teaching, learning, and CPD.

3) Interactive presentations by international experts introduce new ideas about teaching and learning, providing valuable inspiration.

4) Discussion sessions are organized to explore different pedagogical approaches, their benefits, and drawbacks based on educational research. These discussions are an integral part of all CPD Summer School sessions.

5) Reflection and evaluation sessions occur regularly. Daily sessions involve reflecting on one's own learning process during the Summer School sessions. At the conclusion of the CPD Summer School, participants present their User cases, evaluate each other's designs, and engage in a comprehensive reflection on the entire Summer School experience.

Sessions of the CPD Summer School are structured based on an adapted Kolb cycle (see Figure 1).

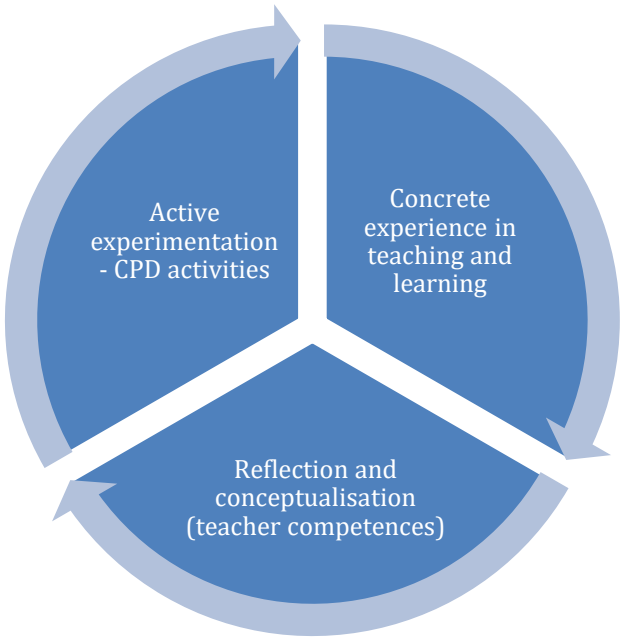

Figure 1. Kolb cycle.

Assessment and Monitoring the Development of Participant Competences in Summer Schools

The culmination of the CPD Summer School experience is the reflection and evaluation undertaken by the participants. This process raises awareness among future CPD Ambassadors of the skills they have developed or improved through their active engagement in the Summer School, as well as the actions they plan to undertake in their local environments.

Throughout the CPD Summer Schools, several approaches and tools are employed to evaluate the intended learning outcomes and provide ongoing feedback on participant progress:

- Rubrics for Evaluation and Self-Evaluation
- Presentations by Participants
- Peer Feedback
- Reflection Sessions

The primary method of evaluation involves assessing the development of User Cases and evaluating the plans for further development and implementation. Presentations and peer feedback sessions occur on the

final day of the Summer School, with peer evaluations guided by rubrics.[4] an example of an assessment tool for the development of User Cases is presented in Table 1.

Tab. 1. Example of rubric for user case assessment.

	Unacceptable (0/10)	**Poor (3/10)**	**Satisfactory (6/10)**	**Excellent (10/10)**
Presentation of the user case	The user case presentation was only drafted	The main characteristics and objectives were presented but not in enough detail	Characteristics and objectives were clear but proposed implementation is only partially explained	Characteristics and objectives were clearly exposed together with the implementation strategy
Expected impact of the user case	The impact of the user case is not present	Only a general impact was considered, but not framed to the local institution	The impact was described and framed to the local institution, but no schedule was provided	A detailed schedule was provided, including the description of the impact and the frame to the local institution
CPD goals	CPD goals are not described	CPD goals are described but the expected impact of the user case are only drafted	CPD goals are described and the impact well framed, but they are not aligned to the local environment	The planned CPD activities are related to the teaching practice / workspace learning.

Self-evaluation holds a significant role in the development of CPD-Ambassadors. "Reflection is a process of reviewing an experience of practice in order to describe, analyze, evaluate, and thus inform learning about practice" (Reid, 1995).

The cultivation of reflective methods and techniques is of particular importance in assessing the activities undertaken by CPD-Ambassadors within their respective universities. For instance, in the case of STEM-CPD Summer Schools conducted during the STEM-CPD@EUni project, online meetings were regularly scheduled in the subsequent year, occurring every few months after the conclusion of the Summer School. These sessions facilitated the exchange of experiences and reflections, providing valuable insights into the progress of the CPD-Ambassadors' work within their local institutions.

The evaluation protocols and assessment methods are available at
https://ectn.eu/wp-content/uploads/2021/06/Evaluation-Protocol_general document_30.06.2021.pdf

The evaluation protocol is described in Table 2.

[4] Rubric is a set of criteria for evaluating assignments (knowledge and/or skills), which usually contain evaluative criteria and description at particular levels of achievement.

Table 2. Evaluation protocol

EVALUATION PROTOCOL: List of questions				
No.	**EVALUATION QUESTION**	**INDICATORS**	**Tools**	**Questions asked to the participants**
1.	**How efficiently was a summer school for CPD Ambassador organized?** **(O5 evaluation)**	1. Participation (%) 2. Dropout 3. Participant satisfaction 4. Relevance of covered topics	Questionnaire (in person / online) Attendance Lists (in person / online)	● Do you feel more confident about your teaching skills? ● To what extent do you think the summer school will affect your daily practice as an academic teacher? In which way? ● Content: to what extent was it new? Versatile? Relevant? What was new for you? ● How do you think it could be applicable the gained knowledge and skills to your teaching practice? ● To what extent do you think the summer school will affect your daily practice as a member of your faculty teaching staff community? ● Do you feel prepared to be a CPD-Ambassador at your institution after the summer school? ● Did you establish any valuable contacts? ● Do you think there was enough interaction with other colleagues? ● Would you recommend your colleagues to participate in such summer school? Why? ● How do you rate the access to teaching and learning material? ● Rate the general organization of the school. ● Rate the technical organization of the school. ● What may be improved in any dimension of the summer school? (e.g., organizational, technical, social, content, etc.) ● Indicate your average attendance of the school. Number of sessions attended. ● What is your main take-home message after attending the school?
2.	**What is the level of learning success of Summer school Participants?**	Number of certificates issued	IO 5 and IO 6 collected data Reflective diary Report of given actions (e.g., MOOC creation)	● What are the CPD activities you would like to organize at your home institution? ● To what extent have you developed a CPD user case to be used at your home university? ● With whom do you plan to work in cooperation? ● To what extent have you got/developed an idea about how to measure the impact of the CPD activities? ● What CPD activities have you proposed to your colleagues? ● Have you cooperated with other European lecturers on CPD activities after the summer school? ● How many times have you contacted people that you met at the Summer School in the last 6 months?

6. Programme of the summer school and description of the sessions

The programmes of the 1st and the 2nd STEM-CPD Summer Schools, held, respectively, in Krakow in 2021 and in Naples in 2022, can be found in Appendix 1.

The design of the summer school is based on the "train the trainer" and co-creation approaches. Within this framework, the summer school program addresses various objectives:

- Imparting innovative active teaching methods for STEM university practice, inspiring CPD Ambassadors to implement these methods in their local universities.
- Conducting discussion sessions on different pedagogical approaches, their advantages, and drawbacks, based on educational research.
- Implementing train-the-trainer methodologies and fostering co-creation to empower CPD-Ambassadors to effectively transmit TPACK knowledge to their colleagues.
- Developing strategies for organizing CPD activities at local universities, tailored to their specific contexts.
- Crafting strategies to promote excellence in university STEM teaching, such as evidence-based course design using educational action research practices.

Self-evaluation plays a crucial role in the development of CPD-Ambassadors. As Reid (1995) states, "reflection is a process of reviewing an experience of practice to describe, analyze, evaluate, and inform learning about practice." The cultivation of reflective methods and techniques is particularly important for assessing the activities undertaken by CPD-Ambassadors in their respective universities.

In the case of STEM-CPD Summer Schools conducted within the STEM-CPD@EUni project, online meetings were scheduled regularly in the year following the conclusion of the summer school. These sessions, occurring every few months, facilitated the exchange of experiences and reflections, providing insights into the progress of the CPD-Ambassadors' work within their local institutions.

To accommodate the heterogeneity among participants and the diversity of their home university contexts, summer schools will offer two distinct types of topics/levels: basic/general and advanced/specific. The design of the summer school allows participants to autonomously select the level of topics that best suits their needs.

The format of the Summer School program is presented here, along with a suggested organizational framework to consider the Intended Learning Outcomes (ILOs) and workload for each session. The sequence of sessions is intentionally structured and not arbitrary.

Get-together event: It is crucial for breaking the ice and establishing the foundation for the community of learners participating in the summer school.

Session 1 Challenges (Problems) in Teaching and Learning at STEM Faculties, STEM-CPD@EUni Roadmap

Intended learning outcomes:

- Tune personal goals for the Summer School considering the expectations of participants.
- Describe who is a CPD-Ambassador and his/her mission.
- Explain the aim of CPD user cases.
- Define a challenge for one's own user case.
- Apply the TPACK approach in designing teaching and CPD activities.

Proposed activities:

- Presentation
- Groupwork (using Miro board)
- Brainstorming session
- Watching knowledge clip
- Assessment activity

Session 2: CPD User Cases and Scenarios

Intended learning outcomes:

- Describe different kinds of CPD activities.
- Define limitations and advantages of different CPD activities.
- Design a User Case based on a local teaching and/or learning challenge.

Proposed activities:

- Presentation
- Groupwork (using a board or Padlet)
- Assessment activity

Session 3 Collaborative Learning

Intended learning outcomes:

- Justify the need for collaboration in education and CPD programs.
- Explain factors to be considered with group work in STEM.
- Create proper conditions for effective collaboration.
- Stimulate and enable cooperation in a sustainable way via the CPD-Ambassadors community.

Proposed activities:

- Presentation
- Groupwork
- Brainstorming session
- Cooperative learning
- Watching knowledge clip
- Use of digital tools (a board - Padlet, survey – Mentimeter)
- Assignments
- Assessment activity

Session 4: Student-Centered Learning (SCL)

Intended learning outcomes:

- Compare deep and surface approaches to learning.
- Recognize your own approach to teaching.
- Explain the difference between student-centered learning and teacher-centered learning.
- Discuss advantages and disadvantages of both paradigms in higher education.
- Design, in cooperation with other lecturers, activities for the local faculty concerning SCL (student-centered learning) and TCL (teacher-centered learning).
- Promote active student-centered teaching and learning practice and person-centered CPD.
- Recognize the features of the teaching model based on constructivist assumptions.
- Describe the advantages of the constructivist approach in teaching.
- Re-design a science education scenario according to constructivism and IBST&L.
- Design, in cooperation with other lecturers, activities for your faculty concerning constructivism and inquiry based science teaching and learning (IBST&L).

Proposed activities:

- Presentation
- Groupwork
- Brainstorming session
- Cooperative learning
- Use of digital tools (a board - Linoit)
- Assessment activity

Session 5: Course Design and Constructive Alignment

Intended learning outcomes:

- Describe the application of constructive alignment in course and CPD activities design.
- Explain the role of ILOs (Intended Learning Outcomes) in effective teaching and learning.
- Prepare rubrics as formative and summative evaluation tools.
- Be aware of the importance of external factors in curriculum design.
- Be able to explain and justify the study program concept and structure.

Proposed activities:

- Presentation
- Groupwork
- Cooperative learning
- Use of digital tools (a board – Padlet, survey)
- Assessment activity

Session 6: Digital Technology and Blended Learning Design

Intended learning outcomes:

- Describe the benefits of blended learning course design compared to face-to-face or online course design.
- Design learning activities in a flipped classroom format using the TPACK approach.
- Analyze course design from the perspective of learning methodologies.
- Explain the elements of online active interactive courses.

Proposed activities:

- Presentation
- Groupwork
- Use of digital tools (a board - Miro, Starfish)
- Assessment activity.

Session 7: How to Design μMOOCs

Intended learning outcomes:

The participant will be able to:

- Advocate for the use of μMOOCs in the professional development of lecturers, providing reasons and benefits.

- Design the structure of interactive online presentations aimed at professional development.
- Describe the designing elements for μMOOCs.
- Propose elements of a μMOOC that ensure online active learning.

Proposed activities:

- Presentation
- Groupwork
- Use of digital tools
- Hands-on activities
- Assessment activity.

Session 8: Development of User Cases

Intended Learning Outcomes:

- Participants will be able to design a user case based on a local teaching and/or learning challenge.

Proposed Activities:

- Presentations
- Group work
- Surveys
- Assessment activities

Session 9: Presentation of User Cases

Intended Learning Outcomes:
Participants will be able to:

- Describe the idea of the local user case in a structured way
- Present the challenges and goals of a user case
- Peer-evaluate and assess a user case

Proposed Activities:

- Presentation of User Cases
- Group work,
- Peer assessment of the User Cases
- Forum discussions

Advanced sessions

Session: Teaching in Laboratories

Intended Learning Outcomes:

Participants will be able to:

- Discuss different approaches to working with students during laboratory sessions
- Explain the role of an assistant at laboratory classes and the influence of collaboration between assistants and their continuous training
- Design effective construction of a laboratory exercise

Proposed Activities:

- Presentations
- Group work
- Brainstorming sessions
- Cooperative learning
- Use of digital tools (such as a jamboard)
- Assessment activity

Session: Designing a study programme curriculum

Intended Learning Outcomes:

Participants will be able to:

- Identify the importance of external factors in curriculum design.
- Explain and justify study program concepts and structure

Proposed activities:

- Presentation
- Open discussion

Session: Teaching Chemistry to Non-Chemistry Majors

Intended Learning Outcomes:

Participants will be able to:

- Explain the problems in teaching chemistry to non-chemists
- Design strategies to successfully teach chemistry to non-chemists

Proposed activities:

- Use of Digital resources for teaching chemistry - MOODLE SCORM
- Discussion
- Questionnaire

Session: Research based teaching and learning. Final level of laboratory classes: doing research with master and PhD students

Intended Learning Outcomes:

Participants will be able to:

- identify the challenges related to supervision and collaboration with your master and PhD students
- identify key points in research-based practice
- develop the contract with your master and PhD student

Proposed activities:

- Presentation
- Exchange of ideas with the use of interactive board (padlet)
- Discussion

7. Design of the CPD-Ambassador certificate

The design of the CPD-Ambassador certificate includes criteria for attributing two different certificates: the Summer School Participation Certificate and the CPD-Ambassador Certificate.

1. **Summer School Participation Certificate:** This certificate will be awarded to participants who attended at least 70% of the activities, whether onsite or online, including both lectures and hands-on activities during the Summer School.

2. **CPD-Ambassador Certificate:** This certificate requires a specific evaluation process with distinct goals. To be eligible for the CPD-Ambassador Certificate, participants must actively engage in CPD activities within their local environment. The CPD activity that the participant undertakes should be related to the development and potential implementation of the User Cases.

- The User Case description should meet certain criteria, including:
- Relevance of the challenge (general importance)
- Realism of the local context and described goals
- Logical setup and description of CPD activities over time
- Description of the expected impact

There is also an option to consider awarding only one certificate based on participation in the Summer School and the successful preparation, presentation, and evaluation of a User Case project. This approach provides immediate recognition and motivation but may not foster post-event community building among CPD Ambassadors.

An example of a certificate can be found in Appendix 2

8. Collection of materials for Summer School

Summer School teaching and learning materials should include examples of scenarios and user cases developed by its participants. All materials will be available online. In the case of 1st and 2nd STEM-CPD Ambassador Summer Schools, User Cases and Scenarios are available on the Starfish platform (https://starfish-education.eu/browse?ftype=usercase).

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Appendix 1. Summer Schools Programmes.

- Krakow October 2021
- Naples October 2022

Appendix 2. CPD Ambassador certificate