

Open Education Resources for Blended modules and MOOCs - Intellectual Output 05 -

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Introduction and use of this document

Overview

This report is an Intellectual Output of the IDENTITIES project. In the proposal, the plan was to produce at least three sets of learning objects (LOs) and three sets of tips for blended courses built up using such LO, corresponding to at least one module of O2 and one of O3.

The creation of Open Educational Resources (O5) was considered innovative and relevant to the project in 2019, since:

- it exploits the potential of the use of multimedia resources and platforms, that enable people with different cognitive learning styles to find their learning path;
- it partially allows to overcome the problem of co-teaching of experts in different fields (mathematics, physics, computer science, engineering, technology), under the condition of appropriating the very innovations of the materials, supported by the general guidelines and additional materials.

The pandemic deeply impacted these plans, since we have been obliged to produce all the modules for online or blended implementations. At the moment of writing the project's proposal, the team could not expect how relevant all the issues connected with distance learning would have become in less than one year.

The pandemic changed dramatically the way researchers and teacher educators communicate, and carry out training activities and ordinary teaching in their university courses. Developing resources and designing online activities for distance teaching-learning has become more and more important in the project. Indeed, we were obliged to delay the first summer school (TLA C1 and C2) and turn it from an in-presence to a distance-learning one. This unexpected event led us to spend more time and energy into the development of such materials, in continuous and strong collaboration, with all the partners, who had to develop their modules from the very beginning in a suitable way in order to face the issue of carrying out implementations in blended learning mode.

All the modules we designed are provided with materials that can be used in blended courses. In this document, we will report the main tools used and the process we followed to design, implement and revise the materials, the tools and the hints for implementation related to the online, synchronous or asynchronous, versions of the activities.

This report contains: the result of a survey, carried out in IDENTITIES to outline the approach to blended learning activities, the initial framework for designing blended courses that we referred to and the process of adaptation of such tools ([Chapter 1](#)); the final products for designing and labelling the activities that compose the submodules, some examples of interactive activities online developed in the project and the videos produced as common resources used in all the modules (videos developed by our expert team about crucial principles of our approach to interdisciplinarity) ([Chapter 2](#)); an evaluation of some of our blended modules as Open Education Resources using the CORRE framework and a brief description of the main steps of the process of revision of the modules after the implementations ([Chapter 3](#)).

Initial state and framework about blended learning activities

Initial conceptions about blended learning

As we anticipated, the experience of the pandemic turned the goal to develop blended modules for preservice teacher education into an imminent emergency, so the team had to come to an agreement about what researchers and teacher educators meant by blended learning and reach a consensus.

After exploring the initial state of the knowledge and experience of the group, we carried out a literature review and shared it with the whole team, coming to common design principles. In this section, we briefly summarize the answers to a survey proposed to 14 members of the IDENTITIES team during a workshop in December 2020. This analysis aimed to understand the IDENTITIES group members' experience with blended learning and e-learning tools, after several months of the pandemic, and to outline an approach to blended learning activities.

1. *What does blended learning mean to you?*

Different meanings of blended emerged:

- a. The coexistence of online and face-to-face activities within the same module (7 people), with some people considering it as teaching to a splitted classroom (half in face-to-face, and half online), while others as teaching face-to-face or online with different synchronous and asynchronous modalities.
- b. The use of online tools and e-learning resources, enriching the teaching-learning process (4 people), with some people considering it within face-to-face lessons, while others within online lessons.
- c. The use of different learning environments at the same time (1 person).
- d. The combination of different instructional strategies (2 people).

The group further reflected that different ways to design a lesson are needed to pursue the same aim of a lesson, depending on modalities (face-to-face or online). In addition, asynchronicity may lead to more difficulties than synchronous mode, and mixing learning methods (both on the teaching and learning sides) is enriching.

2. *What kind of blended learning experiences have you already designed?*

In terms of modalities, different patterns emerged:

- a. *Face-to-face courses* with supporting material for self-study and/or with the use of online resources (4 people).

- b. *Mixed courses* with some activities face-to-face and others online (in some cases in synchronous/asynchronous modes) (3 people).
 - c. *Online courses* with online tools (4 people).
 - d. No experience (1 person) and no answer (3 people).
3. *Which risks and advantages do you see in blended courses compared to courses in presence?*

Several pros and cons were identified, even if most of them seem to relate solely to the online modality of the courses, while others can be clearly referred to the variety of blended learning modalities. Blended methods allow advantages such as richness and personalization of learning, easier and quicker communication and data collection, higher engagement, attendance, and sustainability (even for crisis time and it saves transport time), and more flexibility and autonomy for students. On the other hand, they are more difficult and longer to design and manage for teachers, less emotionally engaging (more distractions or boring), and less human connection, which also makes it hard to adapt the course to the students' emerging needs and that could lead to teacher-centred teaching.

4. *Which kind of technological tools have you already used during your classes?*

The options were LMS (as Moodle, GClassroom, EdEx, etc.), Video conferences apps (e.g. MS Teams, Zoom, etc.), Presentation apps (e.g. PowerPoint, Prezi, etc.), Graphic resources (e.g. Canva, Pixabay, Infogram, GIF, Powtoon, etc.), Video recordings apps (e.g. OBS, Quicktime, Filmora, etc.), Whiteboards (e.g. Padlet, GJamboard, etc.), Spreadsheets (e.g. Excels, GSheets, etc.), On-line form (e.g. GForm, SoGoSurvey, etc.), Quick test apps (e.g. Kahoot, Mentimeter, etc.).

The majority of respondents (more than 10 people) had already used video-conference apps, presentation apps, LMS and spreadsheets, while only 3 people had already used graphic resources and video recording apps, perhaps because they are less known.

5. *What potential do these tools have?*

Several areas of potential were found. First, these tools create interesting learning environments (collaborative, interactive, and engaging). From the teacher's point of view, they allow us to collect data in a quick and even anonymous way, to easily reproduce already done contents, to highlight the learning models, to create course paths that can help to achieve maximum learning outcomes, and with a student-centred approach. Instead, from the student's point of view, they allow easier access to contents and to the "course map", more independent ways to study and immediate feedback on the contents. Furthermore, more students can access the course at the same time.

6. *Do you know other tools that might be useful in a blended course? What purposes do you use them for?*

In addition to the use of web pages with different contents, shared docs, and some examples on different LMS environments, it was suggested the “remote lab-like” app (e.g. PhET, labster, etc.) that allows the simulation of workshop activities.

At the end of the survey, the group discussed and reached an agreement about the meaning of blended learning in the case of the IDENTITIES project. We decided to design activities and submodules flexible enough to be implemented online and in presence, according to the constraints of the specific contexts. In some cases, the materials and the hints are specific for online sessions or autonomous activities, while sometimes the materials are the same for in-presence and online teaching, but we only provide suggestions for online implementation. Even accepting some asynchronous activities and proposing materials, tools and hints for this kind of activities, we decided that the teacher educator should play an active role and that the module would have been designed under the assumption that there will be a trainer, synchronous activities and small group and classroom discussion. We thus interpreted blended learning as an opportunity to be more flexible in terms of time, interaction, and resources for co-teaching but guaranteeing aspects of teaching in presence that we considered necessary.

Designing blended activities and blended courses

In parallel with the survey analysis, the UNIPR team developed a template taking into account one of the proposals of the SELMA group concerning instructional design models. They integrated the template with some specific elements to allow a detailed analysis of the modules produced in the Intellectual Output O2 and O3 by the different working groups. In general, this grid was meant to be useful as a tool to understand what resources were needed for the online transposition of the modules, what kind of new learning objects need to be created and what is gained by doing it online or in face-to-face mode.

During the workshop about blended courses carried out during the meeting in December 2020, each working group was asked to analyze its module by trying to identify the different composing sessions, the duration of each session, the mode of delivery (online or face-to-face, synchronous or asynchronous, in groups or individual), the objectives, the e-learning tools, the on-going evaluation and the pros and cons of the various elements.

The discussion that followed the workshop pointed out the difference between “autonomous” activities, either carried out individually or in group, and “teacher-guided” activities. It was also noted that the activities do not always lend themselves to be done online, and often the transposition from one delivery mode to the other requires a radical change: in particular, workshop activities need a different design approach if proposed face-to-face or online.

Some reflections on designing activities emerged, that have been considered in the design:

- make explicit what you expect from students, e.g. what we want to emerge from discussions, and consequently structure the course.

- consider different commitments and workloads required to carry out online activities, since working online is much more tiring for both the teacher and the learner.
- pay attention to the expected number of involved students, which affects both the methodology and the type of technological and e-learning tools proposed. For example, you should consider that some tools have limitations of use
- some activities that are planned in presence can be adapted to online activities and vice versa, while other activities can not be adapted (like lab activities); however, since the modules were designed during the pandemic we did not plan any activity that could not be carried out online.

The group also had the opportunity to reflect on some specificities of blended learning for STEM disciplines, starting from the reading of a chapter of the Master dissertation by Lorenzo Miani (Chapter 2 - Literature Review of Teaching and Learning STR in Physics Education and Mathematics Education; supervised by Olivia Levrini and Dimitris Stavrou). The dissertation can be found in the [References](#).

The E.S.C.I. course (E-learning Solutions for Course Innovation)

In order to guide the IDENTITIES group in the design of the LOs and the whole courses, the SELMA team adapted and translated in English an e-learning course (E.S.C.I. E-learning Solutions for Course Innovation (english version)) designed for professors of UNIPR during the pandemic. The materials of the course consist of presentations, PDF materials and design tasks. The course is accessible on Moodle at the link: <https://elly2022.corsiformazione.unipr.it/course/index.php?categoryid=6> using this account:

- username: user.identities@nomail.it
- password: Identities22@

In Figure 1, we report a screenshot to show how a module of the E.S.C.I. course is articulated.

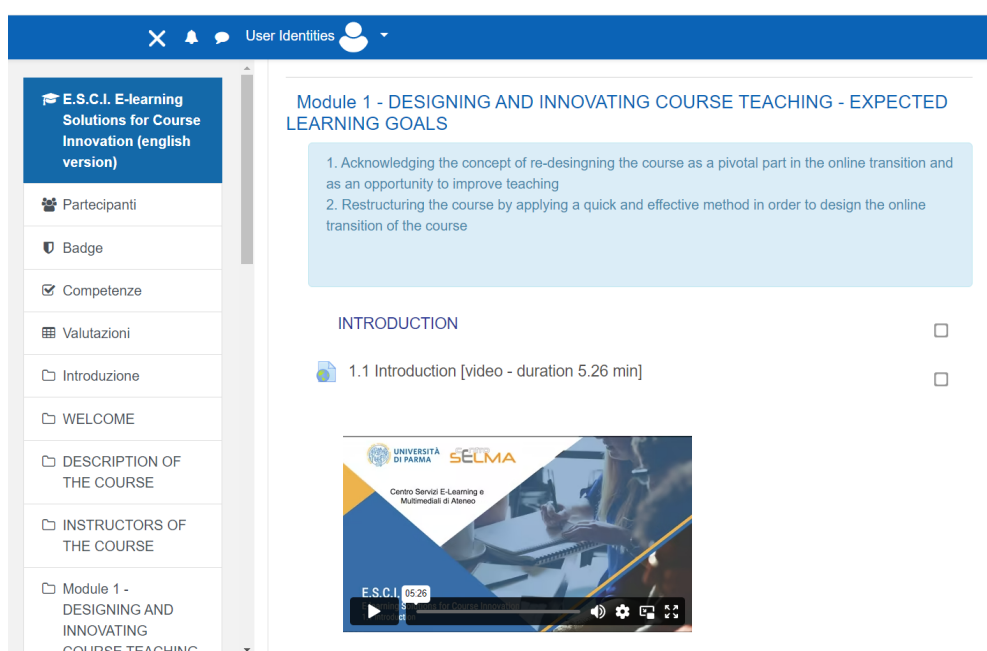


Fig. 1. Example of a module of the E.S.C.I. course

Possible interactions online and suggested digital tools

In this section we describe a table (see Table 1) proposed by the SELMA group which aims at guiding the teachers in the identification of blended activities that could be integrated into a blended course. It is meant to be used as an activity classification framework. Within the IDENTITIES project, we used some of these activities to suggest ways to implement those in our modules in blended mode.

The table serves to identify blended activities by using a key that classifies the selectable options in identified categories depending, firstly, on the desired category interaction and the predetermined objective. In terms of interaction (column A), in fact, two possible modalities have been hypothesized: a teacher/learner interaction and an interaction “between peers”, that is, between learners.

The second classification criterion relates to the specific type of activity, considering the most common LMS systems used (column B). This is a non-exhaustive list that, over time, could be integrated with new types of activities and available resources.

At present, the types of activities proposed are: tests/quizzes, assignments, video-making, the completion of surveys or questionnaires, the forum, the glossary, the diary and podcast (regarding the interaction between teacher and learner) and, in addition to the repeated forums and glossaries, the wiki, the word cloud, the blog, the chat, the workshop, the jamboard and the padlet (to support peer interaction).

The third element of selection (column C) specifies the type of the desired interaction, identifiable according to assessment purposes, in-depth activities, discussion activities, collaboration, and brainstorming.

The last element of classification concerns the timing of the interaction (column D), which can be synchronous or asynchronous.

The table is completed with additional support columns: for example, for each row with an identified blended activity, there is a concrete activity example (column E) and a short description (column F).

Tab. 1. The SELMA framework.

A	B	C	D	E	F
Category interaction	Type of activity	Type of interaction	Timing of interaction	Activities example	Brief description
Teacher/ Learner interaction	Test/Quiz	Assessment	Synchronous/A synchronous	multiple choice test, true/false, drag&drop, matching, short open response, hotspot	Question and answer test delivery. Almost all popular platforms offer layouts and templates for creating all kinds of quizzes. Automated correction is possible and, therefore, immediate evaluation of the learner is provided.
	Assignment	Assessment	Synchronous/A synchronous	e.g. Moodle	Assessment in various text formats (word, excel, .ppt, .pdf, etc.). It involves individual, non-automated correction by the teacher and, therefore, evaluation is postponed.
	Video-making	Assessment/D eepening	Asynchronous	e.g. Wooclap	Production and sharing of a video made by the learner on a specific topic you want the student to deepen.
	Survey/ Questionnaire	Discussion/ Comparison	Asynchronous	free or precompiled responses, that can be anonymous or not	Questionnaires or surveys delivery in order to obtain feedback on a specific topic or on an organizational aspect of the path.
	Forum	Discussion/ Comparison	Asynchronous	e.g. Moodle, wooclap	The forum can be used as a tool for teacher/learner interaction (and it is aimed for evaluation) if the participation of the learner in the discussions is subject to evaluation. Assessments can be given on the number of interventions or responses or on their quality.
	Glossary	Assessment	Asynchronous	e.g. Moodle	It is a specific type of task/delivery that involves the construction of a specific glossary on an aspect of the path or on the total path.
	Journal	Assessment	Asynchronous	e.g. Moodle	Personal report on a topic or an organizational aspect of the path. It can be used both for evaluation purposes and to obtain feedback

Peer interaction (between learners)					from learners.
	Podcast	Assessment/Deepening	Asynchronous	e.g. Wooclap	Production and sharing of audio resources created by the learner on a specific topic you want the student to deepen.
	Wiki	Collaboration	Synchronous/Asynchronous	e.g. Moodle	Construction of encyclopedic content on one or more topics of the course. It has the typical structure of "wikipedia" in which every learner can insert his/her own contribution and can, eventually, review and correct that of others. The set of individual contributions is the overall work that can be evaluated by the teacher and by the participants themselves.
	Word cloud	Brainstorming	Synchronous	e.g. Wooclap, Mentimeter	It is used to brainstorm on a particular input of the teacher, through the publication of individual evocative words/ simple sentences by each learner.
	Blog	Discussion	Asynchronous	e.g. Moodle, Wooclap	Information/editorial content collection tool produced by individual learners.
	Forum	Discussion	Asynchronous	e.g. Moodle, Wooclap	The forum is often used as a tool for peer interaction and discussion. Standard use involves opening discussion topics to be followed by responses from the class group.
	Chat	Discussion	Synchronous	e.g. Moodle, Wooclap	Immediate communication tool between learners, which allows synchronous discussion on a given topic. You can use one-way chat (between two learners at a time) or multi-directional chat (in which all learners participate simultaneously). Unlike the forum, the discussion is less reasoned and more spontaneous. The chat can also be used by the teacher to interact more directly with a single student or with a group.
	Workshop	Collaboration	Synchronous/Asynchronous	e.g. Moodle	It consists of group work in which all learners (or groups) are asked to participate by giving their contribution. Unlike the wiki, the final product is not necessarily a textual content, but it can be any kind of work. The specificity is the

					fact that, in addition to the assessment of the teacher, the final work is also peer-reviewed.
	Glossary	Collaboration	Asynchronous	e.g. Moodle	It is a specific type of task/delivery that involves the construction of a specific glossary on an aspect of the path or on the total path. In this case it can be seen as a specific type of group work.
	Jamboard	Brainstorming	Synchronous/A synchronous		It is an interactive workspace (like "whiteboard") that allows learners to interact on a specific topic through the publication of predominantly visual content (images).
	Padlet	Brainstorming	Synchronous/A synchronous		It is a virtual workspace where it is possible to share contents like "notes" that are useful for the construction of more elaborate paths by the learners.

HOW CAN WE DO TEACHING ACTIVITIES ONLINE?

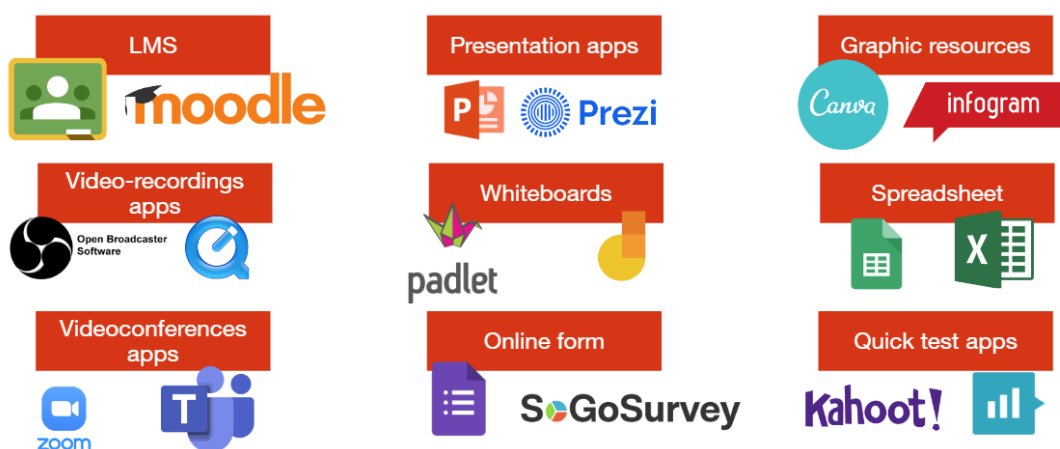


Fig. 2: Different tools for blended learning

Considering the possible types of activities and types of interaction described in Table 1, the group discussed the tools already available and how to exploit them in the adaptation or design of new activities online. A problem discussed was the form of the materials to prepare, both in terms of openness of the available software and of practical issues.

For instance, a Jamboard should be prepared anew and managed by the trainer; similar tools can be used not to oblige the user to own a Google account. In this case, we decided not to provide any open resources that could be directly used but only some hints and a precise description of the scheme of use and interaction foreseen.

In other cases, we prepared ready-to-use resources, like videos or presentations, or sheets. In Figure 2 we show an overview of the different specific tools for blended learning.

Adaptation of the tools for the IDENTITIES project

Starting from the E.S.C.I. materials and from the framework, a starting template with a list of questions to guide the design of the LOs was also given to the group during the meeting in December 2020 ([Annex 1](#)), that was modified and adapted along the project in order to make it more clear and useful to designers of blended activities that foresee phases of synchronous teaching and interactions. Moreover, the grid was re-arranged during the project in order to become not only a tool for designing but also a tool to present the materials and guide an external user to implement the module or part of the module in a specific context, depending on the constraints and conditions.

At the end of this process, the designers of the modules filled the grid clarifying what tools and strategies they had concretely used for blended learning, in national and international implementations. At this stage, the description of the modules was based on what had been done during the project by the different groups and during the Summer schools.

The IDENTITIES team used such grids to frame and scaffold the design and ground the choices related to digital tools and interaction online in synchronous and asynchronous ways, based on references provided by experts in the design of blended learning courses. However, the team discussed with the SELMA team and proposed a customized version of the grid that could include information and hints necessary for interdisciplinary blended activities and considering that the presentation of the modules themselves had to become readable and usable materials for teachers educators. Indeed, the team decided not to design e-learning courses addressed to prospective or in-service secondary teachers and that could be attended only online.

The teams decided to design courses where the teacher educators have an active role and to provide them with materials that can be used in blended courses but under their supervision as active guides, sometimes involved in synchronous or asynchronous discussions, providing feedback to the participants, explaining and clarifying concepts, helping the participants to really question their points of view in interaction with people with a different background. Considering the nature, the framework and the goals of the projects and its specificities, indeed, an authentic interdisciplinary experience that is really relevant for prospective or in-service teachers does not only imply learning new concepts or developing new skills, but accepting to recognize and question one's own point of view. This specificity made the design more complex and led the team to develop new tools that could be suitable to address the challenge to promote transformative and deep exchange in blended interdisciplinary courses. The innovative tools and the results of the process of adaptation are presented in the next chapter.

Hints, tools and objects for blended learning: the specificities of the IDENTITIES blended modules

The Lesson Plan template

In this section we describe the template for the lesson plan (see Table 4) which aims to give a short overview of the IDENTITIES modules for teachers and teacher educators, but with an explicit link to and use of the SELMA framework explained in Table 3.

During the project meetings, and, in particular, in the meeting in Barcelona (July, 2022) the group discussed the issues that emerged in some implementations, in order to revise some activities and tools and reach the final version of the modules. During the meeting in Barcelona the designers of the materials discussed with the SELMA team, and the whole group agreed on a description of the modules in form of a lesson plan including all the information needed by a teacher educator to implement the module. The lesson plans, combined with the description of the module in O4, were the starting point to prepare the presentation of the modules on the website.

The final grid is a lesson plan containing information, materials and hints for implementation that allow the user to decide to implement an activity online or in presence. Moreover, the organization into submodules makes their use more flexible and adaptable to different contexts (e.g. a submodule could be not implemented because of time constraints).

In order to make the materials usable by teachers and teacher educators, external to the project, we elaborated the table reported in Figure 3 with the purpose for each module to explain: the essential aspects of each activity, a suggested tool to use and transform the materials in different blended environments and delivery mode, the expected workload time for students, concerning also in group, individual, and home activities, the links to the materials needed for each activity, both in the non-editable format and in the editable format, when it is possible, and some hints, which can include “a priori” analysis of expectations or a short explanation of how each activity should be conducted (e.g. a comment on how to bring out certain issues from the discussion with students) and other general comments we considered useful.

Fig. 3. The Lesson Plan template.

Modular blocks	Goals of the block	Activities	IDENTITIES approach to interdisciplinarity	Role of participants	Mode of interaction	Suggested digital tools	Workload time	Non-editable format	Editable format	Hints for implementation

All the modules are composed of submodules that can be offered in online settings. The “modular” and flexible nature of the activities in the different submodules allow a teacher educator interested in blended implementation of our modules to take submodules from two different modules and create a new, customized module, exploiting the resources and tips for implementation with digital tools in online settings. Modules can thus be reduced but also recombined thanks to the description in terms of icons and goals; e.g. a teacher educator could implement a module about modelling in curricular and STEM advanced topics, exploiting the common transversal materials (e.g. the videos) in key moments, proposing first curricular activity on modelling from O3 online and in partially asynchronous form and then implementing the COVID modelling module in presence, asking the students to prepare the final presentations about a comparison between curricular and STEM advanced modelling. Of course, some submodules are more significant if implemented after others, but the team made the effort to prepare materials that have specific goals and materials and can be exported. Depending on the conditions and the different curricula, and on the organization of teaching, there are many opportunities to adapt the module and implement them, at least partially, in very different contexts.

Conserving some specificities, the group made an effort to use the same tools, standardized and recognizable terms and a common description of the online activities, in order to make them as context-independent and discipline-independent as possible.

These features of the modules and the availability of resources and hints for online implementation make the IDENTITIES modules easy to disseminate and propose to other teacher educators, not only outside the team but also in other countries.

The icons inventory: type of participants' engagement and online activities

The lesson plan contains both general information related to the module, that have been described in the intellectual outputs O2, O3 and O4, and specific hints about the implementation in blended form.

In this section, we describe the icons used in the lesson plans to characterize the aspect of each activity that concerns its implementation online corresponding to the last set of the three groups of icons. In [Intellectual Output O4](#) all sets are described in detail.

The last set of icons (see Figure 4) refers to the keywords related to the type of participants' engagement in the activities of the IDENTITIES modules, independently from the timing (synchronous or asynchronous), and it is composed of three icons:

1. The icon “individual activity” marks an activity that each participant should carry out on their own.
2. The icon “group activity” marks an activity that should be carried out in groups of at least two participants.
3. The icon “interactive activity” marks an activity where a dialogical interaction between the trainer and trainees is important.

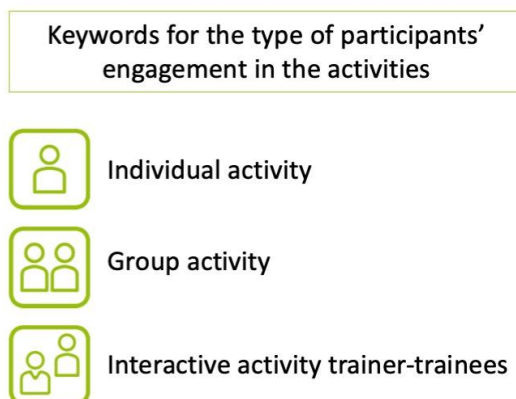



Fig. 4. The third group of icons related to the types of participants' engagement in the activities.

Examples of online interactive activities from the modules


Individual activities online  can be easily assigned as homework or proposed in sessions of individual reading in synchronous activities using documents with guiding questions and asking the students to upload their answers, reports, productions in a folder or send them by email. Another example of individual activity is watching a brief video (e.g, the scaffolding videos). The two individual activities can be combined creating a completely asynchronous slot. In Figure 5 we report an example from the Cryptography module, where students were first assigned to watch a video and then to make comments about it.

Explorer: conclusive questions

1. Thinking about the video, what knowledge (and skills) do you think you need to understand the debate fully and to have a say in it?

2. Thinking about the historical text, which disciplines can you recognize that have contributed to the birth of cryptography? How these disciplines interacted?

Fig. 5. Examples of questions for individual work.

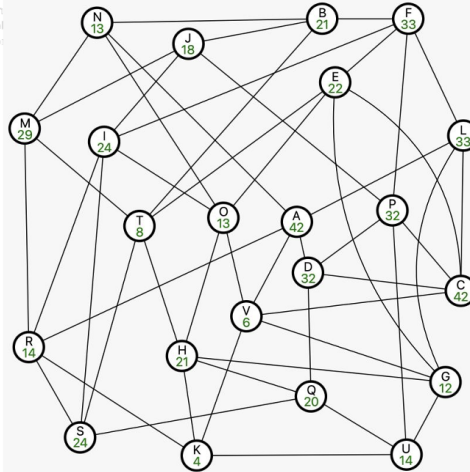
Group activities online  have been carried out by exploiting boards for joint collaborative work or in parallel Zoom sessions. The students have been asked to produce a report of the collaborative work in some cases, preparing a presentation and sharing a recording video of their presentation. In the following, we report some examples from the Cryptography module of different ways we used to organize group sessions.

1- The participants in groups try to decrypt a secret message (Cryptography)

→ Tool: *Jamboard*

→ *Interaction:* The participants are divided into groups and work in parallel. They have the same task (decrypting an encrypted message). They can verify their solution by trying to open the provided treasure chest (at the end of the slides). Each group is given different information. Ideally, the activity is held face-to-face in Zoom sessions with rooms; it has to be synchronous, ideally with a tutor for each group. The most important aspect is the interaction between different participants in trying to decrypt the message. A collaborative tool to write on the graph would be ideal.

Secret message



Verify your decryption

A secret message (a number) has been encrypted.

Go to the following link to verify if you found the plaintext message on the graph.

The number is the key to open this treasure chest.

<https://bit.ly/2Se6Jes>

or, equivalently

<https://snap.berkeley.edu/embed?project=Lock&user=mycol&pauseButton=true>

Fig. 6: Excerpts from the guide for group works where students were asked to decrypt a message

2- Brainstorming on "What do you mean by science?" (Parabola and parabolic motion)

→ *Tool:* Jamboard

→ *Interaction:* Students are engaged to think individually on what they mean by science and then to discuss it all together starting from the post-it on the jamboard. Particular attention is posed on possible stereotyped vision of science.



Fig. 7. Example of a post on a Jamboard in a brainstorming where students were asked to formulate personal questions to deepen the big question "What is science?"

3- Line 2: The role of mathematical models in studying the evolution of the pandemic (Interdisciplinarity at the service of society: interpreting the evolution of Covid-19)

→ *Tool:* Wiki

→ *Interaction:* Students are assigned the following group task "Once you have discussed the questions, we ask you to propose, in groups, a "good" model to understand the evolution of COVID-19. Specifically, we propose that you model the cumulative number of infected people during the first wave to make predictions for the following five days. To do so, you have at your disposal the First_Wave_Data, file which contains two different spreadsheets with the number of daily and cumulative infections for the months in which the first wave of COVID-19 cases in Spain occurred."

- *February_March_April*: contains the data corresponding to 90 days in the months of February, March and April 2020. In addition, two graphs show the different evolution of the number of daily and accumulated infections in these months.
- *Early_May*: contains the data corresponding to the first 10 days of May 2020, which you can use to check the validity of your predictions

We suggest you do it with Excel, Google Sheets or *GeoGebra*. You have two videos to learn the basics of Excel and *GeoGebra* works, but you can use another program if you prefer.

Link to the introductory video to Excel: <https://youtu.be/pMe9nk4-ko>

Link to the introductory video to *GeoGebra*: <https://youtu.be/mHijJ2S1-Ug>

Remember that you can also search and use other external information that may be of interest to you.

Fig. 8. Example of interactive group activity where students can elaborate data from databases and use digital tools, provided with tutorials if necessary

4- Exploring SIR equation-based simulation (Simulations of complex systems)

→ *Tool*: Assignment

→ *Interaction*: Students are asked to examine a basic model of SIR simulation (<https://sites.google.com/site/biologydarkow/physiology/covid-19-sir-simulation?pli=1>) answering in groups the following questions: "Which variable/parameter would social distancing directly impact on in the model? Why? Will social distancing increase or decrease this variable/parameter? Run several simulations and describe how social distancing affects the patterns of system evolution."

The simulation proposed is equipped with a guide that the instructor and the participants can access to investigate more in depth how the simulation works.

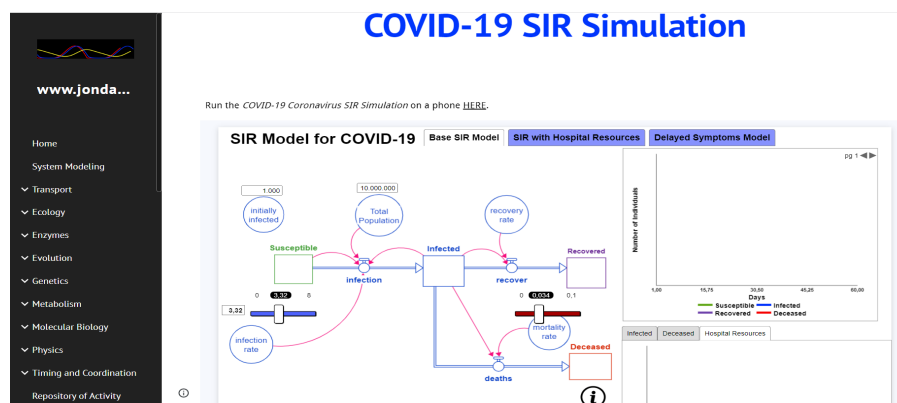


Fig. 9. The interface of the online simulation

5- Participants' presentations (Modelling)


→ *Tool:* Video presentation

→ *Interaction:* Ask the students in groups to prepare a presentation about their modelling activity and a reflection about modelling in physics making a comparison with their answers to the questionnaires at the beginning of this phase. Ask the students to prepare a video of their presentation.

6- Reformulation of a textbook excerpt about the parabolic motion proof reproducing and renovating the textual structure of Galileian dialogue (Linguistic and epistemological activators of interdisciplinarity).

→ *Tool:* Assignment/Video

→ *Interaction:* As in the Galileian dialogue, start from the text of the physics textbook and imagine a dialogue between Salviati and Simplicio (an expert and a non-expert). What would it be like? Share your written dialogue in groups and record a presentation to present it to your colleagues of the other groups.

For **interactive trainer-trainee activities online** , the main tools used were interactive boards (Padlet, Jamboards), WordClouds, Interactive presentations (e.g. ppt with QR codes) or Forums. In all the activities the trainer is expected to collect students' answers, questions, and opinions and to organize students' reactions/answers in order to clarify the goal of the activity and the direction of the joint work. In this kind of activity, the role of boards is thus turned from a sharing tool for students into a tool whose flexibility (posts can be moved and organized in topics). It is very useful to use the same board first to share and then to re-organize the students' answers. Forums are moderated by the trainer and WordClouds or polls are shown and commented on by the trainer. In the following, we report some examples of different ways we used to organize group sessions.

1- Interactive lecture on NST - related real-world problems/applications (Nanoscience and nanotechnologies)

→ *Tool:* WordCloud

→ *Interaction:* To vote for the field where nanoscience and nanotechnologies play a major role. Attention should be given to whether the mentimeter poll results are shown to the students during the voting. If that is the case, then students may also reflect on the ones stated before by peers.

Contemporary problems/challenges:

- Environmental pollution & Climate change
- Energy crisis/global need for fuel
- Overpopulation/increased global need for food
- Healthcare, emerging diseases/need for targeted treatment
- Economical welfare & technological development

Fig. 10: Activity that can be made interactive with a mentimeter poll

2- Comparing equation-, agent-, and network-based models (Simulation of complex systems)

→ *Tool:* Assignment

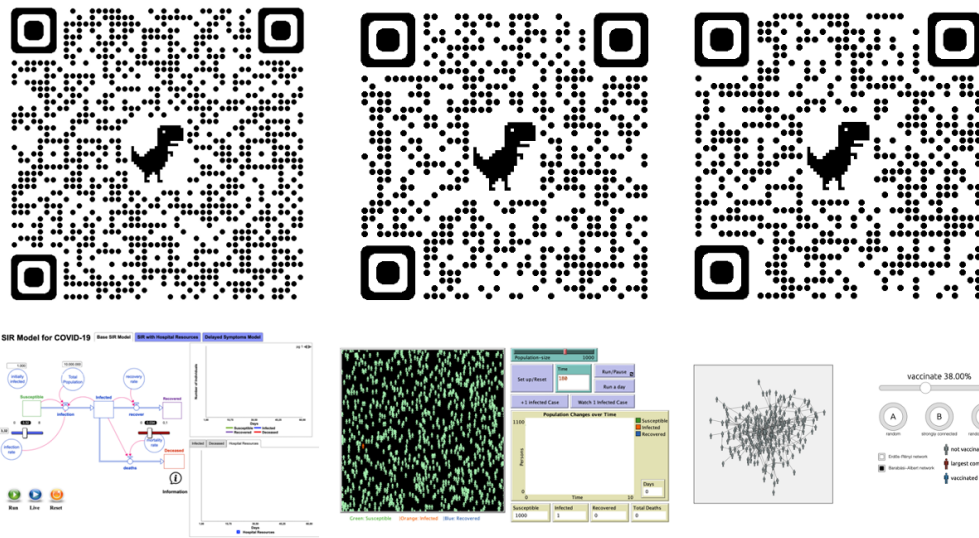
→ *Interaction:* Students are assigned a task with a presentation with QR codes to explore simulations and guiding questions. The students can access the simulations using the QR codes, also in devices that are different from the ones they are using to attend a synchronous session online. The trainer collects the answers and then discusses the comments to the different simulations while students can decide to open them and observe them while the trainer is guiding the classroom discussion.

<https://sites.google.com/site/biologydarkow/physiology/covid-19-sir-simulation>

http://modelingcommons.org/browse/one_model/6279#model_tabs_browser_nlw

<https://www.complexity-explorables.org/slides/facebooked-flu-shots/>

Equation-based Agent-based Network



	Equation-based models	Agent-based models	Network models
What kind of phenomena does the model allow us to deal with?			
Which variables and parameters are chosen to model the system?			

Fig. 11. QR code linked to the simulations and grid to guide the classroom discussion

3- Construction of a causal map on bio-fuels (Climate change)

→ *Tool:* Assignment using an interactive board

→ *Interaction:* Students are asked to complete some maps or identify some loops, stating if there are some positive and negative feedbacks; the trainer led classroom discussion starting from the students' attempts. In an online synchronous lesson and in asynchronous teaching, the teacher can ask the students to reproduce the maps using a Jamboard and the groups can share the screen showing their own maps, or send their

sheets. so the teacher can make comments in real-time or write a feedback showing the examples of the classmates to all the other students

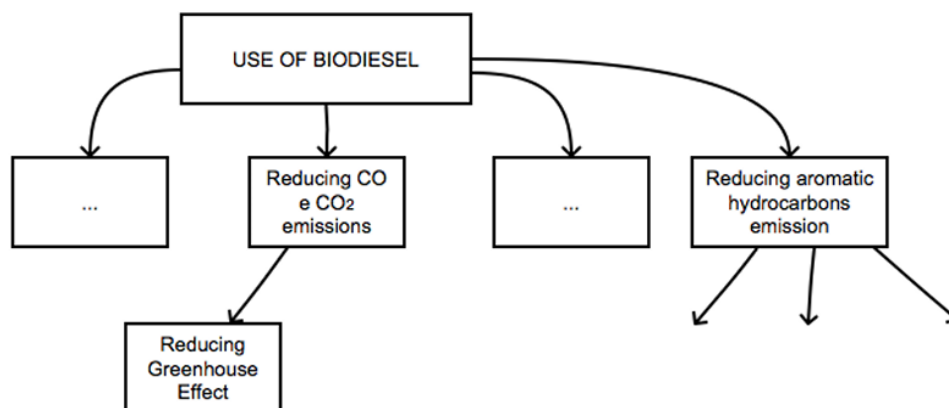


Fig. 12: Example of a map to fill, after reading a text about Biodiesel

The scaffolding videos

Within our project and in collaboration with the SELMA team, we produced four short videos that summarize some crucial aspects in our approach to interdisciplinarity. These videos can be used both to have a first sight of the theoretical background of the project, and to scaffold and foster more transversal reflections.

In the video about the **distinction between O2 modules and O3 modules**, we focus on the tension between the traditional organization of school knowledge in disciplines and the interdisciplinary skills required by the labor market and society. The full video can be watched at the link <https://youtu.be/CSBwQixd-vI>.

In the video about the **taxonomy of interdisciplinarity**, we focus on the meaning of STEM integration in education as working in complex situations on tasks that require students to use knowledge and skills from multiple disciplines and what kind of integration can be adopted. The full video can be watched at the link <https://youtu.be/YEINsxehnxI>.

In the video about the **boundary metaphor**, we focus on an initial overview of the concepts of boundary, boundary object and boundary crossing mechanism that the project took from Akkerman and Bakker (2011) for approaching interdisciplinarity context. The full video can be watched at the link https://youtu.be/fK0XvtFeO_U.

In the video about the **linguistic approach**, we focus on the importance of considering also a linguistic point of view for example to understand how experts talk and write about science, to detect linguistic choices, and to analyze why they have been made and what kind of disciplinary and interdisciplinarity images they convey. The full video can be watched at the link <https://youtu.be/vQV7Id3JIVA>.

Such videos, that can be used for autonomous individual activities or shown during a classroom presentation, have been realized in a first version for the first summer school and

then revised and recorded anew according to the evaluation made by the participants and feedback from the partners.

The first version of the first three videos was tested in the first summer school. After this test, some aspects emerged that should be improved: two videos were too long, the videos were too abstract, and some slides did not help to grasp the main aspects. The texts of the videos were shortened in order to reduce the length to around 5 minutes and the slides of the presentation were turned into more dynamic and engaging ones. The second version of the videos were realized in 2022 and inspired the realization of the fourth video about linguistic aspects of interdisciplinarity.

These resources can be used to introduce the project or as scaffolding activities that provide the students with terms and concepts that help them to re-organized their experience as boundary people. Moreover such resources can be used to introduce the analyst activities, before asking the students to become analysts of interdisciplinarity. They contain the main elements of the framework of the project and are independent of contents. For this reason these resources can be used in every module, also new ones, that the teacher educators would like to design following the IDENTITIES approach. This feature makes the videos highly exportable and easily usable as parts of submodules and included in future modular designs.

Validation of the Learning Objects for Blended learning

The CORRE framework from the OTTER project

In order to validate our learning materials as Open Education Resources, we relied on a workflow framework developed in the context of the OTTER project (Open, Transferable and Technology-enabled Educational Resources) by University of Leicester, UK: the CORRE framework (Content-Openness-Reuse/Repurpose-Evidence). It consists of four overarching stages, namely Content, Openness, Reuse and Repurpose, and Evidence, and correspondent sub-stages, each of them with indicative questions against which they can be assessed on quality, ease of access, adaptability and potential usefulness. Individual academics and OER project teams can use the framework to improve and transform existing instructional materials into OER.

We briefly describe the different stages of the framework based on the more in-depth description that can be found for example in Nikoi, Rowlett, Armellini, & Witthaus (2011). The aim of the framework is explicitly to provide guidance for evaluating existing teaching materials and turning them into OER. To do that, four main stages are identified:

1. *Content*: this stage focuses on gathering existing materials and having a first screen of the content.
2. *Openness*: this step reflects the legal, pedagogical and technical perspectives of turning existing teaching materials into an OER.
3. *Re-use and Re-purpose*: the third stage is about gathering views and opinions from stakeholders on the OER internally and externally to establish fitness for purpose in terms of reuse and repurposability/remixing.
4. *Evidence*: it is concerned with assessing the value and usefulness of OER when released.

Among the modules, the team selected four modules that have been evaluated as Learning Objects (LOs) for blended learning, with particular attention to the fact that the resources could be considered open. The four modules are two O2 and one O3 modules, are led by different universities and are different in terms of teacher-students and students-students interactions, disciplines involved and kind of interdisciplinarity (see O4 at <https://identitiesproject.eu/identities-final-intellectual-outputs/>):

- [Interdisciplinarity at the service of society: Interpreting the evolution of COVID-19](#)
- [Nanoscience and nanotechnologies](#)
- [Parabola and parabolic motion](#)

This selection of modules allowed thus to have a big picture of the way the activities were designed and how the issue of designing interactive activities was addressed in the project. The SELMA team (Manuela Raimondi and Claudia Ledda) evaluated the resources, the

lesson plans and the presentation on the website, selecting among the criteria of the CORRE framework the ones that were more useful for our purposes. The criteria and the evaluation are presented in the next section.

Evaluation of Open Educational Resources (OER)

For the evaluation of OER as Open Educational Resources we use a simple and intuitive framework, based on a question-driven step-by-step process. The framework is typically used by SELMA for the evaluation of LOs and teaching materials to be used in blended and e-learning courses at the University of Parma. The framework, due to its simplicity and adaptability, is transferable to multiple educational contexts. The framework used by SELMA is a simplified adaptation of the process-oriented framework "CORRE" (Content Openness Reuse&Repurpose Evidence) developed in the Open Transferable Technology-enabled Educational Resources (OTTER) project, by University of Leicester, aimed at evaluating and transforming teaching materials into open educational resources (Nikoi, Rowlett, Armellini & Gabi, 2011). As in the CORRE method, the evaluation of resources is guided by a series of questions, which in the SELMA framework are mainly oriented towards verifying accessibility, correctness, usability, and adaptability.

The specific objects of the SELMA evaluation are the materials related to three modules: Parabola and Parabolic Motion, Interdisciplinarity at the service of society: Interpreting The Evolution of COVID-19, and Nanoscience and Nanotechnology. For all of these, the focus of the evaluation is their degree of "openness", i.e., the relevant factors that justify how each material can be considered "open".

In the broadest definition, open educational resources (OERs) are educational resources that are freely accessible to anyone who has internet access. Unlike physical textbooks published by traditional publishers, students can easily access OERs online. In addition, these resources are not only open to be accessed but also approved to be edited as needed to make them helpful for a specific course. It is possible to access OERs through online hubs, such as the OER Commons, which functions as a digital library for this type of resource.

To evaluate OER, we assess, first, whether the resource is compliant with the project's requirements, is aligned with learning objectives, and holds clear value for learners.

The evaluation criteria of the SELMA framework are:

- authority (about who authored the material)
- accuracy (check for typographical errors, formatting errors, or serious gaps in information)
- objectivity (if there are possible bias)
- currency (the time when the resource was created)
- coverage (if the OER sufficiently covers the topic)
- accessibility (with respect to students and project's accessibility guidelines)
- license (about who owns the copyright for all the resources and the possibility to make changes or edit the resource)
- purpose: (for what purpose was the resource created, for what type or level of students and what its goal is in term of teaching those students)

For the evaluation of O5 as OER, we focused on some of these criteria, and in particular on **authority, accuracy, currency, accessibility** and **license**. The following considerations are valid **for all three modules**.

In all three modules, we can consider a wide variety of OER, each ranging in depth of information provided and overall complexity. The materials include text resources, including PDF documents, video resources, such as lectures and tutorials, static visual resources, such as templates and interactive educational resources.

The guiding questions to evaluate the **authority** are:

- Can you clearly identify the author of this resource?
- Is the creator of this resource a well-regarded name in his field?

Regarding the **authority** (who created the material), it is possible to assess that the authors of all the materials of the three modules must be considered subject matter experts.

The guiding questions to evaluate the **accuracy** are:

- Is the content largely free of major typos or formatting errors?
- Can you independently verify the facts included in the resource, and are they correct?

The textual type materials have been examined and validated in relation to Accuracy and no critical issues have been found. In particular, we didn't find clear errors that jump out at a first reading, such as typographical or formatting errors. Similarly, other type materials, as videos, for example, are accurate in visuals, graphics, speaking and subtitles. In addition, the facts included in the resources are complete and correct. For this reason, it is possible to positively evaluate the OER also in terms of **accuracy**.

As for the **currency**, we have the following guiding questions:

- When was the resource created?
- Was it created recently?
- If not, when was the resource last updated and by whom?

In relation to this criterion, it can be said that all the resources are recently created (from 2019 to 2022), specifically refined for the O5 part of the Identities project and, therefore, updated to the most recent developments of the topics covered in the three modules. Therefore, the **currency** of the various OERs also obtains validation within the SELMA framework.

To evaluate the **accessibility**, one of most important criteria for "openness", the guiding questions are:

- can all students, regardless of ability, access this resource?
- is the resource compliant with the project's accessibility guidelines?

For all three modules it is possible to easily validate these aspects without problems since each page of the modules (see [Nanoscience and Nanotechnology](#), [Interdisciplinarity at the service of society: Interpreting The Evolution of COVID-19](#) and [Parabola and Parabolic Motion pages](#)) contains an accessible and downloadable "module's lesson plan". The module's lesson plan offers a detailed list of the OERs, each one accessible through a link.

All links have been verified as open and working for access and download. Furthermore, each OER is clearly identified by user-friendly icons that make their identification and use for users intuitive and simple. The aspect of **accessibility** in the validation of the openness of the OER is very relevant in all three modules.

Finally, regarding the **license** criterion, the questions are:

- who owns the copyright for the resource?
- Are you allowed to make changes or otherwise edit the resource to make it more useful for your course, if needed?

These elements can also get a positive validation for all three modules. The intellectual property of the contents is mainly attributable to the authors of the three modules and, in all cases in which external or third-party resources are cited, the correct reference and citation are highlighted. It is recommended to indicate the source of the images when requested by the original owner. Finally, textual or interactive OERs are always available and downloadable also in editable format, so that it is possible for each user to make changes or edit the OER, in order to make it more suitable for other specific purposes.

In conclusion, the OER of the three modules can be considered open based on these criteria. They are available to users to be used as the main resource in a course or to supplement existing resources. The valuable aspect is that all the OERs of the three modules have been created as a full set of course materials, graphics, and digital learning objects, suitable to illustrate key points, templates to base specific lessons on, or PDF documents to support existing materials.

The benefit for potential users is immediately evident: all the OERs are immediately available online as soon as it's needed.

All the selected module resources meet the challenges posed by OERs very well because of the open nature of these resources, which are primarily focused on content quality: the quality of the learning contents is consistent as it is supervised and created by experts in the field and the formatting of digital resources is coherent and suitable for being formatted in a different ways, in a completely "open" perspective.

Implementations and revision cycles

The hints for online implementation included in the lesson plan are based on previous implementations of the materials in international Summer schools or national contexts.

As we anticipated, the pandemic accelerated the development of resources for online preservice teacher education. During the first year the modules on the parabola and parabolic motion, cryptography, Interpreting The Evolution of COVID-19 and Nanotechnologies have been implemented only online, in synchronous and asynchronous ways.

The partners involved prospective teachers in local implementations (O2, O3, O5), experimenting the variety of courses (in-presence, blended), collecting data and producing reports to shared in the conference calls to enable the partnership to discuss and refine the first modules (O2, O3, O5). In particular the partners shared their experiences of teaching in blended courses (half in presence, half in distance learning). In January and February 2021 the UNIPR team analyzed the recorded meeting, the answers to an online form and the group's design processes and asked the groups to develop their design according to some advice to send their sheets by the end of March.

The first four modules were implemented and tested in the first Online Summer schools C1 and C2 at the end of June 2021. The other modules have been designed for in presence activities, but the materials have been designed thinking about their use online or the adapted version of the material for online teaching with suitable tools.

The materials developed for the first Summer school and in local implementations have been revised for further implementations according to the results of the questionnaires to participants and researchers' notes. The new materials and activities have been designed using similar design strategies and the materials for in presence activities have been mostly created from the beginning as resources that could also be used in blended courses, also in online distance settings.

The final version of the materials and hints for online teaching are reported in the Lesson Plans on the website (<https://identitiesproject.eu/modules/>). If it is not precisely expressed, the open resources have been designed in order to be usable in online teaching (in the slides there are links to videos or online resources, or in the lesson plan there are mentions to Jamboard or Padlet, that should be created by the users). If different materials are suggested for in-presence and online teaching it is written in the hints for implementation.

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Annex 1: First version of the grids to design the blended modules and adapt them to a new context

Tab. 3. The first template for module planning

Module Planning									
*Duration / Online-Live / Synchronous-Asynchronous / Group-Individual work / Session Objectives									
Session/ Blocks	Part	h *	O - L *	S - A *	G - I *	O b *	eLearning tools	Ongoing monitoring	Pros & Cons
In which sessions can the module be divided?	In which parts can each session be divided? <i>The different parts can refer, for example, to different methodologies</i>						What tools could students use to achieve the learning outcomes? What techniques could you use to help facilitate learning? Are there eLearning technologies or tools that could be used to help achieve / demonstrate achievement of the learning outcome? <i>We suggest to indicate for each learning tool to be prepared who is responsible for its preparation</i>	How will feedback be given to students regarding their achievement of the LO? What assessment methods will help to inform and improve student progress toward this learning outcome? Are there eLearning technologies or tools that could be used to help achieve / demonstrate achievement of the learning outcome?	Thinking of each activity, what are the pros and cons of blended implementation in its various articulations?

Tab. 4. The Online Planning for alignment

Course code and name			
Semester to be offered (e.g. F17)		Expected time for development (e.g. 12 months)	
Expected number of students		Expected instructional support (i.e. number of Teaching Activities?)	
Context of the course			
Why is this course offered? <ul style="list-style-type: none"> - Where does it fit within the program? - Is this a theoretical, experimental, applied or basic course? - How/why is it relevant to the learners, other courses in the curriculum, and to society? - Have there been any current and important developments in the course topics? 			
Can you describe the profile of a student you expect to have in the course? <ul style="list-style-type: none"> - What is their life experience/situation (e.g. new to university, mature, professional)? - What are their disciplinary backgrounds, prior knowledge and experiences related to the course topics? - What do you think students will be interested in this course? 			
What will be some key strengths of this course? <ul style="list-style-type: none"> - What do you think that will work easier in the course? - What makes it innovative? - What key areas of the course would you like to strengthen and build upon? 			
What will be some key challenges of this course? <ul style="list-style-type: none"> - What mainly obstacles do you expect that you will have to address, improve upon or change? 			
What is your experience with online learning? As either a learner or as an instructor <ul style="list-style-type: none"> - Do you have any concerns about developing an online course? 			
Curriculum Planning (It can be used to plan the entire course. Dividing the course by modules)			
Learning aims and outcomes	Assessment methods	Teaching and learning activities (TLAs)	eLearning tools

<p>What are the learning outcomes you expect from students?</p> <p><i>A typical course will have between 5-8 course-level learning outcomes.</i></p>	<p>What assessment methods will provide evidence that students have achieved the LO?</p> <p>How will feedback be given to students regarding their achievement of the learning outcomes?</p> <p>What assessment methods will help to inform and improve student progress toward this learning outcome?</p>	<p>What TLAs will students actively engage in as they progress towards this learning outcome?</p> <p>What TLAs will help to achieve the learning outcome?</p> <p>What activities will foster social and teaching presence?***</p>	<p>What tools could students use to achieve the learning outcomes?</p> <p>What teaching techniques would facilitate students' learning?</p> <p>Are there eLearning technologies or tools that could be used to help achieve / demonstrate achievement of the learning outcome?</p>

***Design questions for social and teaching planification	
Social presence	Teaching presence
<ul style="list-style-type: none"> - How will the course design help all members be seen as "real" people? - How will students get to meaningfully interact with other class members? - How will the course design help support a collaborative learning environment? - How will a course climate be created that is both intellectually challenging yet respectful? 	<ul style="list-style-type: none"> - How will students meaningfully engage with the instructor or teaching team? - How will the instructor set and maintain a climate for learning? - How will the instructor be present in the direct instruction of course material? - How will the instructor be present in the facilitation of course learning experiences?
Development Plan	
I will develop...	I will seek assistance developing...