Erasmus +: BLISS

Blended Learning Implementation for reSilient, acceSsible and efficient higher education

Project 2021-1-SE01-KA220-HED-000023166

Project Result 2 – Deliverable 2.2.1 Research Diary

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Edited By: Roberto Sala, Fabiana Pirola, Giuditta Pezzotta, UNIBG

Reviewed by: Antonio Maffei, Fabio Marco Monetti, KTH

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Project title:	**Blended Learning Implementation for reSilient, acceSsible and efficient higher education**
Project result:	**2**
Leading org.:	**University of Bergamo**
Output title:	**Requirement for new curricula definition**
Authors:	**University of Bergamo with input from the entire consortium**

Project Result 2 summary:

Project Result implementation

Analysis of the available literature in BL. This activity is aimed to contextualize the Covid-19 experience and suggest a novel view based on highlighting and structuring the use of successful patterns emerging from the study. The literature will be also complemented by a specific LTT about BL hosted by the Royal Institute of Technology. This activity will concur in producing the result 2 and contribute to the general literature in the domain

- **Needs analysis** Blended strategies are widely considered more efficient than fully online or in-person approaches, as they promote engagement, offer flexibility, and reduce costs for students and institutions. This hybrid approach is particularly beneficial for achieving complex learning goals, prompting many HEIs to transform their curricula. The BLISS initiative aims to support these efforts by leveraging data from the pandemic and identifying best practices. A successful blended learning strategy involves balancing face-to-face and online time while considering factors like feedback, digital literacy, and workload.
- **Target group** This activity directly targets teachers and program coordinators at HEIs in the consortium. However, its open results will benefit similar roles in other institutions as well. The reflection on best practices will also support future students studying the defined curricula. These curricula are based on the requirements identified through this activity.
- **Elements of innovation** This task will analyze existing literature in the context of the Covid-19 pandemic. The new perspective will highlight how HEIs can enhance the resiliency of their educational offerings. It will also explore ways to increase efficiency and engagement. Finally, it aims to improve accessibility.
- **Expected impact** This task will provide the theoretical foundation to define improved curricula based on rational use of blended learning.
- **Transferability potential** Both the research diary and the requirement specification will be transferred to the academic learning community through an open-access publication and shared through the planned dissemination activities (see related section)

Division of work

Activity Leadership and Planning UNIBG led this activity and organized the related work as planned.

Task 2.1 Literature analysis. Starting from the necessity to have a complete overview on the experiences described in the literature for the implementation and use fo Blended Learning approaches in the engineering courses, a literature analysis was carried out. After defining the research query, papers were classified according to the learning approach presented (i.e., Face-to-Face, Rotation, Flex, Labs, Self-Blend, Online), each partner institution was assigned to a single learning approach with the scope of analyzing the related papers (Table 1). During the analysis, each institution had to fill out a research diary in Excel format with required information to collect.
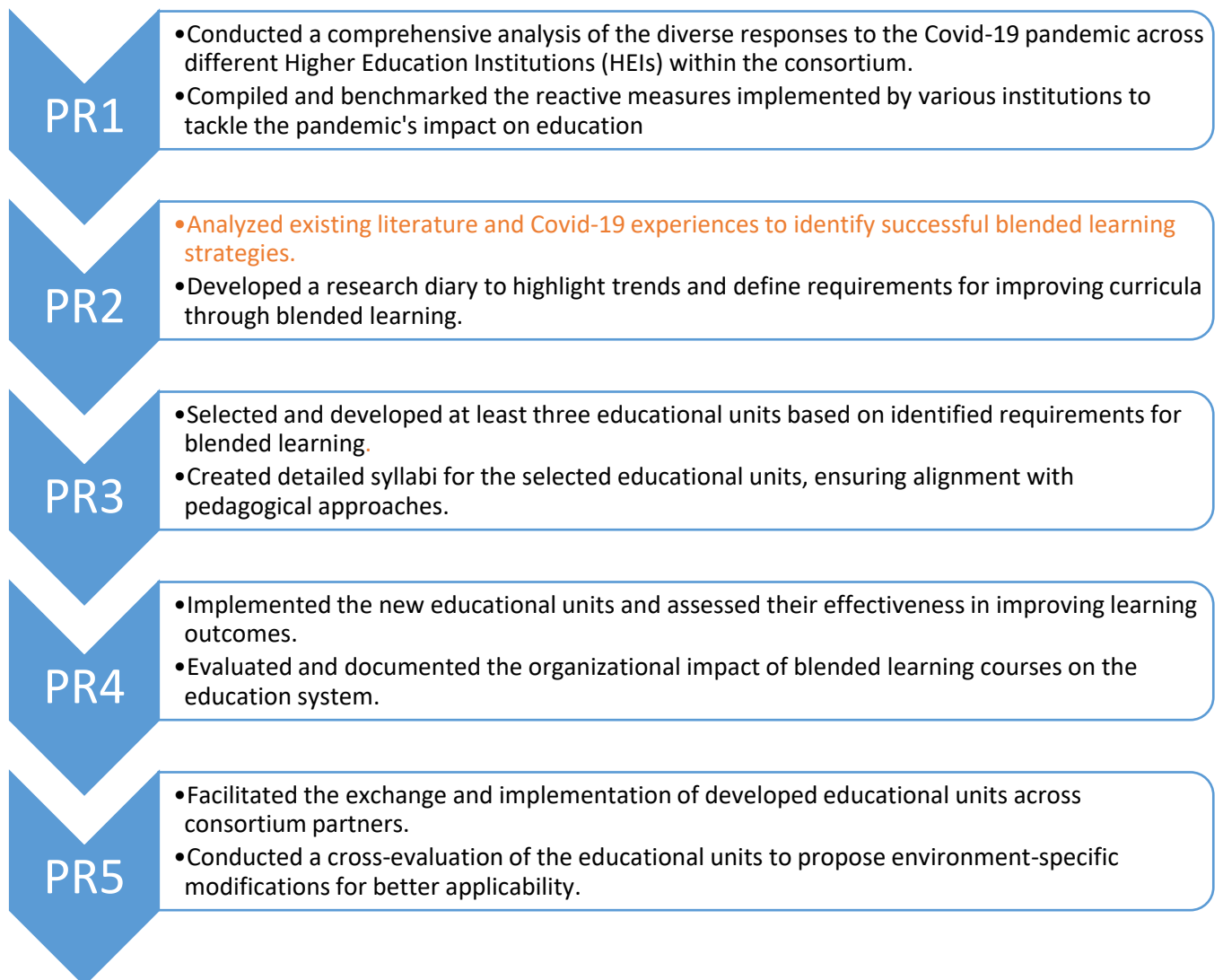
Table 1 - Learning approach and insitutions

Learning Approach	Short-Description	Institution
Face-to-face	The teacher drives the instruction and augments with digital tool	UNIBG
Rotation	Students cycle through a schedule of independent online study and face-to-face classroom time	KTH
Flex	Most of the curriculum is delivered via a digital platform and teachers are available for face-to-face consultation and support	FLEX
Labs	All of the curriculum is delivered via a digital platform but in a consistent physical location. Students usually take physical classes in this model as well	UNILJ
Self-Blend	Students choose to augment their physical learning with online course work	UNIMA
Online driver	Students complete an entire course through an online platform with possible teacher check-ins. All curriculum and teaching is delivered via a digital platform and face-to-face meetings are scheduled or made available if necessary	UNIRI

Task 2.2 Synchronization and research diary. Starting from the results of the previous task, UNIBG collected the single institutions' research diaries and scheduled a series of meeting to discuss the resolution of doubts emerged during the classification. As an output, a consortium research diary was obtained. This research diary contained the classification of all the papers extracted from the literature analysis and covered all the learning approaches. The synchronization of the research diaries was made with the contributions of all partners through a series of online meetings.

Task 2.3 Requirement for a new curricula definition. Following the creation of the consortium research diary, the file was analyzed to extract trends and capture the main insights that was possible to gain from the literature. Starting from this, a set of requirements for the definition of new curricula was created. Additionally, an open access paper, with the main insights and lessons learned, as well as the list of requirements, was published.

Project Result 2 in the context of the Project

PR1
- Conducted a comprehensive analysis of the diverse responses to the Covid-19 pandemic across different Higher Education Institutions (HEIs) within the consortium.
- Compiled and benchmarked the reactive measures implemented by various institutions to tackle the pandemic's impact on education

PR2
- Analyzed existing literature and Covid-19 experiences to identify successful blended learning strategies.
- Developed a research diary to highlight trends and define requirements for improving curricula through blended learning.

PR3
- Selected and developed at least three educational units based on identified requirements for blended learning.
- Created detailed syllabi for the selected educational units, ensuring alignment with pedagogical approaches.

PR4
- Implemented the new educational units and assessed their effectiveness in improving learning outcomes.
- Evaluated and documented the organizational impact of blended learning courses on the education system.

PR5
- Facilitated the exchange and implementation of developed educational units across consortium partners.
- Conducted a cross-evaluation of the educational units to propose environment-specific modifications for better applicability.

Results of the activities

The Project Result 2 goal was to define a set of requirements for the creation of new curricula based on Blended Learning in the engineering field. The definition of a standard classification approach for the single institutions' diaries favoured their integration into a complete consortium research diary and, in turn, the development of the analyses.

Query definition and paper classification

The query run in Scopus was the following: "TITLE-ABS-KEY (("blend* learn*") AND "engineer*") AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "ENGI"))". It was run at the beginning of the project and then at the beginning of 2023 to check any important deviations. The query initially returned 206 papers. Reading the title and abstract allowed to reduce the number of papers to 158. Finally, the reading of the full text allowed to reach the final pool of 103 papers to be analyzed.

The papers were initially clustered according to the learning approach discussed in the title and abstract. In case the paper discussed multiple approaches, the paper was assigned to all the involved partners.

A brief description of the learning approaches is provided in **Error! Reference source not found.**.

In addition to the standard information related to each paper (e.g., year of publication, source) the following information was extracted from each paper:

- Relevance to the research (High/Medium/Low)
- What research gap is the paper trying to address
- Country of application
- Degree level (if any) (e.g., Bachelor, Master, PhD)
- Degree year (if any)
- Degree (if any)
- Course (if any)
- Technology typology
- Technology (specific)
- Learning_Approach
- Blooms_Level_Face_to_Face
- Blooms_Level_Online
- Results
- Related to covid (Yes/No)
- Phase of the covid (Before/During /After)

Bloom's Taxonomy

In this conceptualization, 6 different, increasingly sophisticated, levels of understanding are identified. Each level is then populated with a set of verbs that represents the associated learning actions. In detail:

Table 2 - Bloom's Taxonomy

Level	Name	Verbs	Description
1	Remembering (Recall and Recognition)	Define, duplicate, list, memorize, repeat, state	At this level, learners recall and recognize information without necessarily understanding its meaning. They can define terms, reproduce facts, or list items from memory.
2	Understanding (Comprehension)	Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate	Learners grasp the meaning of information and can explain it in their own words. They are able to classify, describe, or identify concepts and ideas.
3	Applying (Application)	Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch	At this level, learners use their acquired knowledge to solve problems or apply concepts in real-world situations. They can demonstrate skills and implement solutions.
4	Analyzing (Analysis)	Differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test	Learners break down information into its components, identify patterns, and make connections. They can analyze and evaluate relationships between different elements
5	Evaluating (Evaluation)	Appraise, argue, defend, judge, select, support, value, critique, weigh	At this level, learners make judgments about the value, validity, or quality of information. They can argue a point of view,

6	Creating (Synthesis)	Design, assemble, construct, conjecture, develop, formulate, author, investigate	The highest level of Bloom's Taxonomy, learners generate new ideas, concepts, or products. They can design solutions, create hypotheses, and contribute to new developments.

Definition of the research diary at consortium level

The single insistutions were in charge of extracting information from the papers according to what has been described earlier. After, recurring meetings were scheduled to discuss the classification results in order to clarify doubts and justify choices made by the partners. These meetings allowed to clarify for all the partners the approach for classification and clarify doubts that might emerge. Additionally, these meetings also served as a confrontation space for the final classification of the papers that were assigned to multiple partners in the first place due to the presence of multiple learning approaches.

Due to the format, the final research diary is not reported in this word document but is attached as Annex in Excel format under the name "D2.1.1 – BLISS Research Diary".

Suggested Readings

1. M. Mabkhot, Mohammed, et al. "Mapping industry 4.0 enabling technologies into united nations sustainability development goals." Sustainability 13.5 (2021): 2560.
2. Lupi, Francesco, et al. "Toward a sustainable educational engineer archetype through Industry 4.0." *Computers in Industry* 134 (2022): 103543.
3. Antonelli, Dario, et al. "Tiphys: an open networked platform for higher education on industry 4.0." *Procedia CIRP* 79 (2019): 706-711.
4. Maffei, Antonio, et al. "CONALI ontology. a framework for design and evaluation of constructively aligned courses in higher education: putting in focus the educational goal verbs." *Procedia CIRP* 50 (2016): 765-772.
5. Maffei, Antonio, et al. "On the design of constructively aligned educational unit." *Education sciences* 12.7 (2022): 438.
6. Sala, Roberto, et al. "Blended learning in the engineering field: A systematic literature review." *Computer applications in engineering education* 32.3 (2024): e22712.
7. Maffei, Antonio, and Fredrik Enoksson. "What is the optimal blended learning strategy throughout engineering curricula? Lesson learned during Covid-19 pandemic." *2023 IEEE Global Engineering Education Conference (EDUCON)*. IEEE, 2023.
8. Sala, Roberto, et al. "Examining the implementation of Blended Learning in the Engineering field." *5th International Conference on Higher Education Learning Methodologies and Technologies Online*. 2023.