Erasmus +: BLISS

Blended Learning Implementation for reSilient, acceSsible and efficient higher education

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

Project Result 4 – Deliverable 4.2.2 The amended set of ILO, TLA, and AT.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them

2022-2025

Edited By: Dario Antonelli, Paolo Minetola, Paolo Priarone - POLITO

Reviewed by: UNIMA

Table of Contents

Document heading

Project title:	**Blended Learning Implementation for reSilient, acceSsible and efficient higher education**
Project result:	**4**
Leading org.:	**POLITO**
Output title:	**Implementation and evaluation of the proposed educational units**
Authors:	**Dario Antonelli, Paolo Minetola, Paolo Priarone**

Project Result 4 summary:

Project Result implementation

Needs Analysis:

The organization of course materials was deemed of utmost importance. Recognizing that a well-organized course is not only manageable but also transparent for all stakeholders, the Consortium partners, all utilizing Learning Management Systems (LMS) such as Moodle, acknowledged the need for different methods and functionalities for face-to-face (F2F) and e-learning programs. The pandemic necessitated a shift from F2F to e-learning, highlighting the inadequacy of traditional and fully online course organization for the new blended learning approach adopted in Result 3. To address this, ILO, TLA, and AT developed in Result 3 were field-tested to identify potential organizational issues. Additionally, the project sought to determine if the new blended learning courses measurably improved learning outcomes from the student perspective.

Target Groups:

The target group comprised teachers and prospective students of the implemented and evaluated educational units. The results were made available to all consortium institutions and beyond.

Elements of Innovation:

Blended learning, categorized into skill-driven, attitude-driven, and competency-driven learning, offered diverse applications within Higher Education Institutions (HEIs). Recognizing that student education extends beyond course attendance to include group works, seminars, theses, and academic challenges, the project innovatively integrated the learning outcomes proposed in Result 3 into the standard engineering programs of the consortium HEIs. To the best of the BLISS consortium's knowledge, this constituted the first pilot course set encompassing the full spectrum of proposed blended learning approaches.

Expected Impact:

This activity provided a significant and unique learning opportunity for the entire consortium. The knowledge generated proved fundamental in enhancing the project's final output and fostering continued cooperation.

Transferability Potential:

The evaluation procedure was designed for easy replication in any new blended learning application. To enhance communication and mutual understanding of expertise, a specific training activity (C2) was conducted following a consortium meeting in Turin in June 2024.

Deviations from planned time

The End Date of the activity was postponed from 28 February 2024 to 30 November 2024 in order to allow all the partners to complete their educational unit following their respective academic schedules. The delay has not caused any further delay in the project conclusion.

Conversely the consortium meeting and the specific training activity was moved from February to 24-28 June.

Division of work

POLITO coordinated the activity, involving all partners according to their specific technical expertise.

T4.1: Execution of Educational Units:

The proposed educational units were implemented through various pilot courses at all the institutions within the BLISS consortium. Feedback from teaching staff and learners was gathered through course evaluations and specifically designed roundtable discussions involving all stakeholders. The C2 workshop was also included as an additional means of testing the proposed learning blocks.

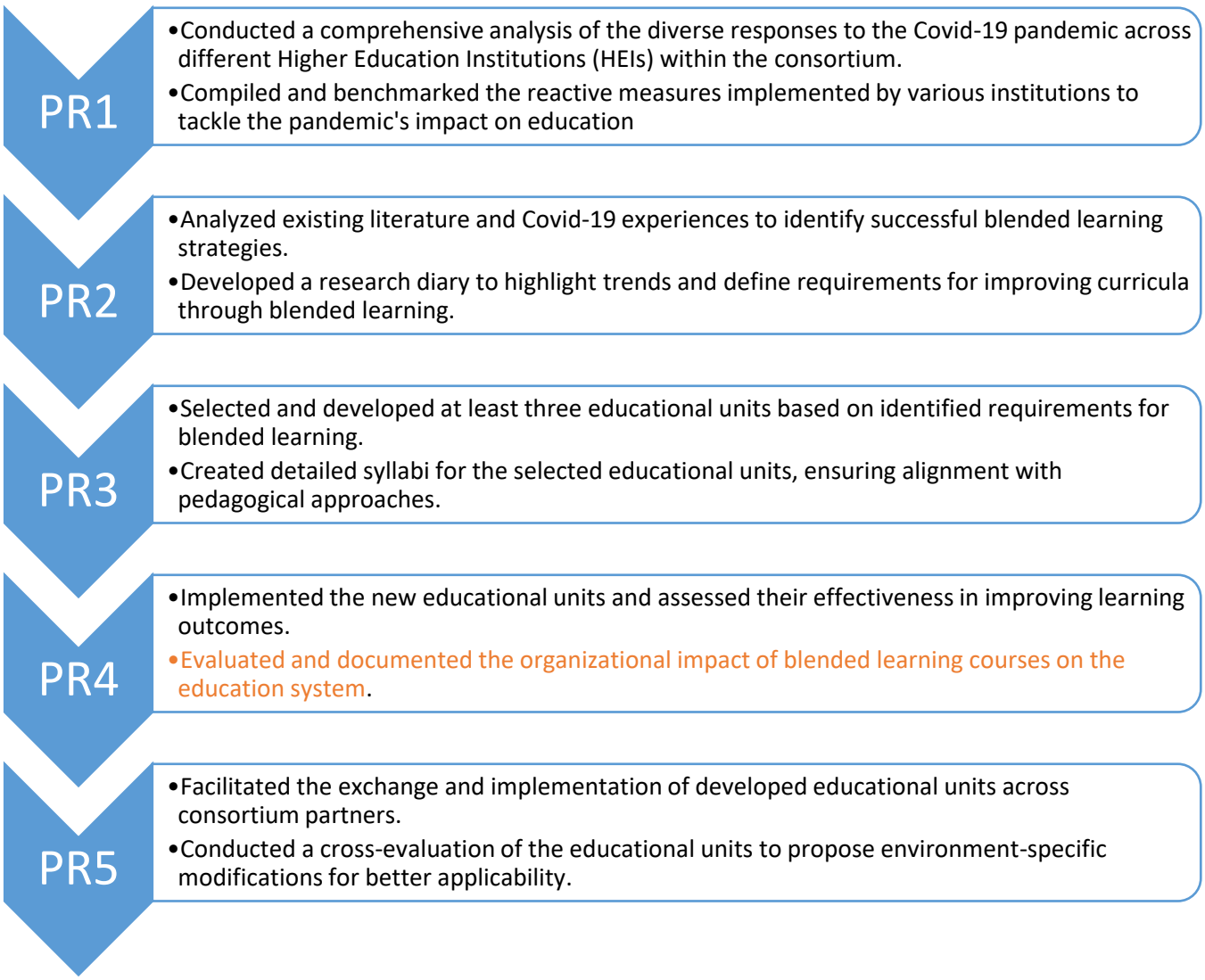
T4.2: Feedback Analysis and Improvement:

The results from T4.1 served as input for an improvement process focused on aligning stakeholder expectations with the actual course implementation. The analysis encompassed operational, tactical, and strategic levels, with assessment projected on dimensions such as learning objective achievement, reduction of teacher workload, lessening of student cognitive load, and organizational impact. This feedback analysis facilitated the refinement of the proposed set of ILO, TLA, and AT.

Two reports were generated:

- Deliverable 4.2.1: Documented the quality assessment procedure employed in the feedback analysis. (Present report)
- Deliverable 4.2.2: Presented the amended set of ILO, TLA, and AT (Present report).

Project Result 4 in the context of the Project



Results of the activities

The overall modifications to the educational units

The feedback from students and educators was distilled in modifications to both the teaching and learning activities and to the assessment of the educational unit. The common issue highlighted in the students and

teachers feedback is the reduced participation and engagement during the activities online. This issue has been addressed differently depending on the specific policy of Blended Learning implemented by every partner University.

Table1 presents the list of implemented educational units.

UNIVERSITY	E.U.	DATE	COMPLETED
KTH	Scientific Methodology for Production Engineering	Spring 2024	✓ YES
POLITO	Production Systems	Spring 2024	✓ YES
UNIBG	Operation Management	Autumn 2023	✓ YES
UNIMA	Artificial Intelligence in Engineering Quality and Reliability Engineering	Autumn 2023 Autumn 2023	✓ YES ✓ YES
UNILJ	Discrete Control Systems Mechatronic Actuators	Autumn 2024 Autumn 2024	✓ YES ✓ YES
UNIRI	Operating Systems	Spring 2024	✓ YES

Modifications to the Educational Unit at KTH University

At KTH University, modifications were made to the educational unit based on feedback from students and follow-up discussions within the teaching team.

- **TLAs were not modified.** The TLAs were considered appropriate for building the necessary knowledge for the task.
- **Assessment Task 2 was modified.** Initially, it was held in real life (IRL) in the class, but now students are offered the opportunity to do it IRL or online via Zoom.
- **Additional modifications:** Some of the debate topics will be modified next year with new ones related to sustainability issues in specific production engineering contexts. The teaching team deems those more relevant for KTH students.

Motivation for the Assessment Task 2 modification:

Feedback from students and follow-up discussions within the teaching team highlighted how there was no real pedagogical gain in holding the two sessions (presentations) exclusively IRL. On the other hand, the possibility to join remotely increases accessibility and inclusiveness for working students.

Modifications to the Educational Unit at POLITO University

The modifications to the educational unit at POLITO include increased use of technology, active learning, enhanced communication and feedback, community building, and accessibility and flexibility. These changes aim to improve student engagement and participation in a blended learning environment.

TLAs

The changes in the TLAs are as follows:

- Increased use of technology.
- Introduced additional online quizzes and interactive exercises.
- Incorporated additional multimedia elements.
- Implemented collaborative learning activities.
- Encouraged student-led discussions and presentations.
- Created problem-based learning scenarios.

ATs

- Introduced formative assessment activities.
    - Purpose: To monitor student learning and provide ongoing feedback.
    - Timing: Occurs throughout the learning process.
    - Feedback: Provides specific and descriptive feedback.
    - Stakes: No-stakes, doesn't impact grades.

Modifications to the Educational Unit at the University of Malta

The University of Malta made several modifications to the educational unit based on student feedback.

> Modifications were made to the Teaching and Learning Activities (TLAs) to enhance the engagement and effectiveness of the online asynchronous delivery. The Assessment Tasks (ATs) were updated to enhance student engagement and encourage active participation in the learning process.

Unit 1

TLA (Teaching and Learning Activities):

- Interactive elements were incorporated into the online asynchronous delivery, including short presentations with embedded quizzes and discussion prompts.
- An online discussion forum was introduced to foster student interaction and encourage reflective learning.
- These changes aimed to address student feedback about the online content being lengthy and monotonous, creating a more dynamic and participatory learning experience.

AT (Assessment Tasks):

- **AT 1.1** was revised to include scenario-based multiple-choice questions, enabling students to apply theoretical understanding to real-life situations.
- A new **AT 1.2** was introduced, incorporating peer evaluation in the online discussion forum. Students will provide feedback on their peers' responses based on set criteria, promoting collaboration, critical thinking, and deeper reflection.

Unit 2

TLA (Teaching and Learning Activities):

- **TA 1.3** has been added to enhance the learning experience by providing students with personalized feedback and recommended further reading based on their results from TA 1.2. This will be delivered asynchronously online, allowing students to review their performance and deepen their understanding at their own pace.

AT (Assessment Tasks):

- **LA 1.3** has been added to support student learning through online presentations and videos available on Moodle. This content will be delivered asynchronously, allowing students to engage with the material at their own pace and revisit key concepts as needed.

Modifications to the Educational Unit at the UNIRI University

The modifications to the educational unit of the UNIRI University are as follows:

- In TA 1.3, demonstration of applying statistical tests now involves different software solutions, as well as custom-programming with dedicated Python libraries.
- In TA 1.5, providing a clear feedback after a students' presentation and joint discussion is included.
- Assessment task 3 was added.

What: In **TA 1.3**, demonstration of applying statistical tests now involves different software solutions (not only one specific software), as well as custom-programming with dedicated Python libraries (see bold):

"Demonstrate an example of applying a statistical test, and how results and conclusions should be reported. **Different software solutions can be utilized, including Python libraries in online environment.** Encouraging questioning and discussion."

Why: Most students preferred the Python environment over specific software whose functions they had to learn from scratch (e.g. SPSS trial version).

What: In **TA 1.5**, providing a clear feedback after a students' presentation and joint discussion is included (see bold):

"Organize student presentations. Ask questions and encourage a collaborative discussion on the case study following each presentation. Evaluate the presentations / reports according to the rubric previously given. **Provide feedback for each mock-up case (student/group) via LMS.**"

Why: Although all the pros and cons of the presented mock-up case are analyzed orally during the discussion in class, students can learn a lot from more detailed written feedback that corresponds to the given rubric.

What: **Assessment task 3 added**

Why: The mock-up case study was originally conceived as a learning and teaching activity that strengthens the skills of conducting statistical analysis, which are needed in a project that is worked on throughout the

semester. However, the student's engagement in the mock-up case study itself can be subject to assessment and thus a good indicator of what needs to be paid extra attention to.

Modifications to the Educational Unit at the UNILJ University

The modifications to the educational unit of the UNILJ University are as follows:

- TLA – changed

What: In LA 1.1. an introductory video for the usage of Jupyter Notebook was added. The modified text now says: “Students write notes and fulfill self-assessment questionnaires (online; 10 minutes with prompt feedback). At home students watch the introductory video for Jupyter Notebook”

Why: Nowadays Python is what Matlab used to be more than 10 years ago, meaning the tool that students mainly use prior to attending this course. As a consequence, they have preference to use as much Python as possible.

Modifications to the Educational Unit at the UNIBG University

TLA – Modified

The Teaching and Learning Activities (TLA) have been updated to improve interaction and effectiveness while ensuring compliance with existing regulations. The main changes are:

Modifications to Teaching Activities

- **TA 1.3 (Feedback and Support):** An interactive feedback session has been added to help students consolidate their acquired knowledge and apply it more effectively.
- **What changed; (blue bold text)**
- TA 1.3 Assist students and provide **interactive** feedback in group exercises on the application of methods to model business processes

- **TA 2.3 (Simulation Support):** Two specific support sessions have been introduced to guide students in creating simulation models and analyzing them critically.
- **What changed; (blue bold text)**
- TA 2.3 Assist students and provide **individual and practical feedback** on the production of simulation models to analyze business processes through **individual** meetings and in-class support

Modifications to Learning Activities

- **LA 1.3 (Group Exercises and Feedback):** Now includes an additional peer review phase before discussion with the instructor to encourage collaboration and comparison.
- **What changed; (blue bold text)**
- LA 1.3: Practice with case study resolution in groups, **discuss the results in dedicated class sessions** and ask for support for clarification of doubts.

- **LA 2.3 (Case Study and Simulation):** Students will be able to present their work in a structured feedback session to receive suggestions and guidance before the final evaluation.

- **What changed; (blue bold text)**
- LA 1.3: Practice with case study resolution in groups, **discuss the results in dedicated class sessions** and ask for support for clarification of doubts.

Detailed Results

KTH

ILO reference (Highlight the Verb)	Assessment task 1	Assessment task 2	Assessment task 3
ILO 1 Gather information and elaborate a strategy to qualify and defend an opinion on a controversial topic, and analyse and summarize the consequent debate	verb: gather, analyse Activity type: Written report Retrieve information related to the topics using ChatGPT. Analyse relevant information given the group debate strategy. List the motivation for all arguments choices and the related references. Report the collected and analysed information. Grading: pass/fail	verb: summarise Activity type: Oral presentation Present orally the results of the debate in front of the class. **(Flexible on Zoom or IRL).** Grading: pass/fail	verb: elaborate Activity type: Debate exercise Create the debate strategy based on the different roles in the debate. Implement the created strategy during the debate **(Flexible on Zoom or IRL).** Grading: pass/fail

POLITO

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning[1]
ILO 1 - The student will be able to outline and express with mathematical models the technological properties of the materials used for production	TA 1.1 – Presentation of the technological properties of materials TA 1.2 - Solution of selected exercises and calculation examples. Training of an AI tool on the dataset of solved exercises. TA 1.3 – Regular feedback to the students in presence and online. Correction of students' solutions TA 1.4 – Propose at the end of the Unit a problem-based learning scenario with open-ended solution	LA 1.1 - Listen to the explanation, take notes, and ask questions. LA 1.2 – Review the notes and find similar solutions applicable to the given problems and exercises. LA 1.3 – Compare the solutions with the correction given by the teacher or suggested by the AI tool. LA 1.4 – Propose a feasible solution to the problem-based learning scenario and have it reviewed by the AI.	• The 1st principle is reflected in LA numbers: 1.1. • The 2nd principle is not reflected here • The 3rd principle is reflected in LA numbers 1.2. • The 4th principle is reflected in LA numbers 1.3. • The 5th principle is reflected in LA number 1.1, 1.2. • The 6th principle is reflected in LA numbers LA 1.2. • The 7th principle is reflected in LA numbers 1.2 and 1.3.
ILO 2 - The student will size a given manufacturing process, optimizing the technical and economic performances and taking into account quality, safety and sustainability issues	TA 2.1 – Presentation of the optimization method for process performances TA 2.2 - Explain the procedures for executing the feasibility study, the sizing and the optimization of manufacturing processes TA 2.3 – Introduce the problems to the students	LA 2.1 - Listen to the explanation, take notes, and ask questions LA 2.2 – Review the notes, find similar solutions applicable to the given problem LA 2.3 – Analyze the problems, explicit the quality constraints, apply the known methods	• The 1st principle is reflected in LA numbers: 2.1. • The 2nd principle is not reflected. • The 3rd principle is reflected in LA numbers 2.2, 2.3. • The 4th principle is reflected in LA numbers 2.3. • The 5th principle is reflected in LA number 2.1, 2.2, 2.3.

[1] 7 principles of good learning:

1. encourages contact between students and faculty,
2. develops reciprocity and cooperation among students,
3. encourages active learning,
4. gives prompt feedback,
5. emphasizes time on task,
6. communicates high expectations
7. respects diverse talents and ways of learning - Arthur W. Chickering and Zelda F. Gamson (1987)

	TA 2.3 – Assist students during the analysis of the problem TA 2.4 – Propose at the end of the Unit a problem-based learning scenario with open-ended solution	LA 2.4 – Propose a feasible solution to the problem-based learning scenario and have it reviewed by the AI.	• The 6th principle is reflected in LA numbers LA 2.3. • The 7th principle is reflected in LA numbers 2.1, 2.2, 2.3.
ILO 3 - The student will be able to chose, integrate and deploy the manufacturing steps as a coordinate system oriented to the making of an industrial product (process plan)	TA 3.1 - Assign individual classwork to design conceptual process planning TA 3.2 - Assign group classwork to chose, integrate and deploy the manufacturing steps of a detailed process plan TA 3.3 – Participate to the discussion groups of students, orienting the discussion TA 3.4 - Organize a final wrap up opportunity	LA 3.1 – Review the notes, find similar solutions applicable to the given problem LA 3.2 - Distribute tasks among the group. LA 3.3 - Write a checklist of activities and monitor the progress of the work. LA 3.4 - Discuss in groups and solve the case study. LA 3.5 - Discuss with the AI the weak points and the threat in the proposed solution to the case study.	• The 1st principle is reflected in LA numbers: 3.1. • The 2nd principle is reflected in LA numbers 3.2 and 3.3. • The 3rd principle is reflected in LA numbers 3.4. • The 4th principle is reflected in LA numbers 3.4. • The 5th principle is reflected in LA number 3.1, 3.2, 3.3, 3.4. • The 6th principle is reflected in LA numbers LA 3.2. • The 7th principle is reflected in LA numbers 3.1 and 3.2.

ILO reference (Highlight the Verb)	Formative assessment	Summative Assessment task 1	Summative Assessment task 2
ILO 1 - The student will be able to outline and express with mathematical models the technological properties of the materials used for production.	Verb 'express' Activity type: self-assessment questions on the technological properties of the materials	Verb outline Activity type: Written questions Answer theoretical questions on the technological properties. Grading: assessing by scores: 1 for exact answer, -1/4 for wrong answer, 0 for no answer	Verb express Activity type: Written exercises Solve numerical problems on the technological properties. Grading: assessing by scores: [0-8]
ILO 2 - The student will discuss a given manufacturing process and will optimize its technical and economic performances, taking into	Verb Optimize Activity type: self-assessment questions on the process optimization	Verb Optimize Activity type: Written exercises	

account quality, safety and sustainability issues.	Activity type: online exercises on process optimization with the automatic correction of results and comparison with the correct solution	Solve numerical problems on the process optimization. Grading: assessing by scores: [0-8]	
ILO3 - The student will be able to chose, integrate and deploy the manufacturing steps as a coordinate system oriented to the making of an industrial product (process plan)		Verb Integrate Activity type: Written exercises Solve numerical problems on the process optimization. Grading: assessing by scores: [0-8]	Verb Deploy Activity type oral presentation: present and discuss the chosen solution Grading: assessing by scores: [0-30]

UNIMA

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning
ILO 1 Remember and understand the theoretical and background knowledge of Six-sigma process improvement methodologies.	TA 1.1 Present Theoretical and background knowledge of six-sigma process improvement methodologies **using short, interactive presentations with embedded quizzes.** (Online asynchronous delivery) TA 1.2 Explain additional engineering tools in conjunction **with Six-Sigma through interactive discussion prompts or activities embedded in the LMS** (Online asynchronous delivery)	LA 1.1 Listen, take notes and read around the topics. **Engage in interactive quizzes embedded in the learning material to** Assess knowledge recall. **Participate in an online discussion forum to share reflections and questions about the topics.** LA 1.2 Listen, take notes and read around the topics. **Engage in interactive quizzes embedded in the learning material to** Assess knowledge recall. **Participate in an online discussion forum to share reflections and questions about the topics.**	Encourages contact between students and faculty TA 1.1, TA 1.2, LA 1.1, LA 1.2 encourages active learning. TA 1.1, TA 1.2, LA 1.1, LA 1.2 gives prompt feedback TA 1.1, TA 1.2, LA 1.1, LA 1.2

ILO reference (Highlight the Verb)	Assessment task 1	Assessment task 2	Assessment task 3
ILO 1 Remember and understand the theoretical and background knowledge of Six-sigma process improvement methodologies.	Verb: Remember and Understand - **Scenario-based** multiple choice questions that require students **to evaluate and apply their theoretical understanding**	**Verb: Evaluate** **- Peer evaluation of responses in the online discussion forum.** **Students provide constructive feedback and rate peers responses based on**	Verb: Remember and Understand - Exam essay question Describe the concept presented in the class on an example use-case.

	Mark the correct / incorrect statements. Grading: points (0 - 10)	**relevance, clarity and application of concepts.** **Grading: points (0 - 10)**	Grading: points (0 - 10)

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning
ILO 1 **Select** and **apply** appropriate statistical tests on data obtained from a HCI experiment and **derive** the conclusions according to their outcomes.	TA 1.1 **Present** standard statistical tests typically used for data obtained from a HCI experiment. TA 1.2 **Explain** how the appropriate test should be chosen, according to the design of the HCI experiment. TA 1.3 **Demonstrate** an example of applying a statistical test, and how results and conclusions should be reported. **Different software solutions can be utilized, including Python libraries in online environment.** Encouraging questioning and discussion. TA 1.4 **Present** (**prepare** and **deliver** via LMS) a small-scale case study: a hypothetical HCI experiment (description) and corresponding data (online data generators can be utilized). **Provide** web links to online tutorials and supplementary learning material. Recommend possible software tools. Provide a rubric (checklist). **Support** students online (via LMS forum).	LA 1.1 **[in classroom]** **Listen** to the presentation, take notes and ask questions. LA 1.2 **[in classroom]** **Listen** to the presentation, take notes and ask questions. LA 1.3 **[in classroom]** **Listen** to the presentation, **observe** the demonstration, take notes and ask questions. LA 1.4 **[outside classroom]** Analyze the description and data from the obtained mock-up case. **Select** the appropriate statistical test for a given case study. **Utilize** the online resources (tutorials, wide web search), and get familiar with the software selected for statistical analysis. **Apply** statistical analysis (within software tool), **derive** conclusions, write and submit report via LMS. If necessary, ask for help / clarifications on the LMS forum (teacher support available). Prepare a presentation.	Encourages contact between students and faculty LA 1.1, LA 1.2, LA 1.3, LA 1.4, LA 1.5 TA 1.1, TA 1.2, TA 1.3, TA 1.4, TA 1.5 Develops reciprocity and cooperation among students LA 1.5 TA 1.5 Encourages active learning LA 1.3, LA 1.4, LA 1.5 TA 1.3, TA 1.4, TA 1.5 Gives prompt feedback LA 1.3, LA 1.5 TA 1.3, TA 1.5 Respects diverse talents and ways of learning LA 1.5 TA 1.5

	TA 1.5 **Organize** student presentations. Ask questions and **encourage** a collaborative discussion on the case study following each presentation. Evaluate the presentations / reports according to the rubric previously given. **Provide feedback for each mock-up case (student/group) via LMS.**	LA 1.5 **[in classroom] Present** case study analysis. Answer the teacher's questions and actively **participate** in the joint discussion of other cases.	

ILO reference (Highlight the Verb)	Assessment task 1	Assessment task 2	Assessment task 3
ILO 1 **Select** and **apply** appropriate statistical tests on data obtained from a HCI experiment, and **derive** the conclusions according to their outcomes.	Verb: **Select** Exam question **Answer** questions regarding the selection of the appropriate statistical test, according to the given description of the HCI experiment design and the available data. **Grading:** Assessment by grade. The answer to the question can be awarded a full score (for a complete answer), a partial score (for an incomplete answer) or zero points (for a completely incorrect or non-existent answer).	Verb: **Apply**, **derive** Project activity / Project report **Apply** the appropriate statistical tests on data obtained within a Project (HCI empirical research). **Report** the results in a standard/formal way, and **derive** the conclusions (generalizations) accordingly. **Grading:** In overall project assessment, points are awarded or not (or partially assigned), depending on the success of this project activity. The statistical analysis brings altogether 1/3 (max. 20) project points (remaining 2/3 (max. 40) corresponds to the implementation of the interactive system, and organizing and conducting the HCI experiment).	Verb: **Apply**, **derive** **Mock-up case as an AT** **Apply** the appropriate statistical tests on the mock-up data from a given case-study. **Report** the results in a standard/formal way, and **derive** the conclusions (generalizations) accordingly. **Grading:** 0 – 5 points, according to the given rubric.

UNILJ

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning
ILO 1 The student should be able to program a discrete version of the PID control algorithm on an Arduino microcontroller and analyze the stability of the close loop system	TA 1.1 The teacher presents (lecture) the PID control algorithm, z Transform, teacher hands out self-assessment questionnaires. TA 1.2 The teacher explains (lecture) the concept of stability and introduces criteria for system stability. The teacher presents ICCT-Interactive Course for Control Theory (developed within previous Erasmus+ project). TA 1.3 The teaching assistant demonstrates how to program a PID control algorithm on an Arduino microcontroller	LA 1.1 Students write notes and fulfill self-assessment questionnaires (online; 10 minutes with prompt feedback). At home students watch the introductory video for Jupyter Notebook LA 1.2 Students write notes, use ICCT to gain additional knowledge (interactive examples, self-assessment tasks) LA 1.3 Students are divided into pairs and program a control algorithm on an Arduino microcontroller	Prompt feedback, respects diverse talents and ways of learning, develop reciprocity and cooperation among students, encourages active learning,

UNIBG

ILO reference (Highlight the Verb)	Teaching Activity (What the teachers do)	Learning Activity (What the students do)	How does this use the 7 Principles of good learning
ILO 1 Describe business processes in the operations management domain and illustrate them using BPMN2.0	TA 1.1 Theoretically present methods to model business processes TA 1.2 Provide tutorials to model business processes using BPMN2.0 TA 1.3 Assist students and provide feedback in group exercises on the application of methods to model business processes	LA 1.1 Listen, take notes, and ask questions LA 1.2 Listen and practice with exercises to model business processes using BPMN2.0 LA 1.3 Practice with case study resolution in groups and ask for support for clarification of doubts.	encourages contact between students and faculty LA 1.1, LA 1.2, LA 1.3 develops reciprocity and cooperation among students TA 1.2, TA 1.3 LA 1.2, LA 1.3 encourages active learning TA 1.1, TA 1.2, TA 1.3, LA 1.1, LA 1.2, LA 1.3 gives prompt feedback TA 1.3, LA 1.1, LA 1.2, LA 1.3

			respects diverse talents and ways of learning TA 1.1, TA 1.2, TA 1.3, LA 1.2, LA 1.3
ILO 2 Produce discrete event simulation models of business processes in the operations management domain with AnyLogic, and analyze and compare their performance	TA 2.1 Theoretically present methods to simulate business processes TA 2.2 Provide tutorial to simulate business processes using discrete event simulation in AnyLogic TA 2.3 Assist students and provide feedback on the production of simulation models to analyze business processes through meetings and in-class support	LA 2.1 Listen, take notes, and ask questions LA 2.2 Listen and practice with exercises to simulate business processes with discrete event simulation in AnyLogic LA 1.3 Practice with case study resolution in groups and ask for support for clarification of doubts.	encourages contact between students and faculty LA 2.1, LA 2.2, LA 2.3 develops reciprocity and cooperation among students TA 2.2, TA 2.3, LA 2.2, LA 2.3 encourages active learning TA 2.1, TA 2.2, TA 2.3, LA 2.1, LA 2.2, LA 2.3 gives prompt feedback TA 2.1, TA 2.2, TA 2.3, LA 2.1, LA 2.2, LA 2.3

			respects diverse talents and ways of learning TA 2.1, TA 2.2, TA 2.3, LA 2.1, LA 2.2, LA 2.3

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, https://doi.org/10.3390/su13052560
2. Lupi, Francesco, et al. "Toward a sustainable educational engineer archetype through Industry 4.0." Computers in Industry 134 (2022): 103543, https://doi.org/10.1016/j.compind.2021.103543
3. Antonelli, Dario, et al. "Tiphys: an open networked platform for higher education on industry 4.0." Procedia CIRP 79 (2019): 706-711, https://doi.org/10.1016/j.procir.2019.02.128
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, https://doi.org/10.1016/j.procir.2016.06.004
5. Maffei, Antonio, et al. "On the design of constructively aligned educational unit." Education sciences 12.7 (2022): 438, https://doi.org/10.3390/educsci12070438
6. Sala, Roberto, et al. "Blended learning in the engineering field: A systematic literature review." + Computer applications in engineering education 32.3 (2024): e22712, https://doi.org/10.1002/cae.22712
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, https://doi.org/10.1109/EDUCON54358.2023.10125225
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, LINK
9. Lombardi, Dario; Traetta, Luigi; Maffei, Antonio; Podržaj, Primož. "Enhancing Instructional Design: The Impact of CONALI Ontology and ChatGPT in Primary Education Training." Computer applications in engineering education 32, no. 3 (2024), https://doi.org/10.1002/cae.22712
10. Bonello, Amberlynn, et al. "Development of an Agile Blended Learning Framework for Engineering Higher Educational Instutions post Covid-19. " Journal/Conference: Proceedings of the 33rd International Electrotechnical and Computer Science Conference, pages 644-647, e-ISSN 2591-0442, LINK
11. Antonelli, Dario, et. al. "Exploring the limitations and potential of digital twins for mobile manipulators in industry" Procedia Computer Science, V. 232, P. 1121-1130, https://doi.org/10.1016/j.procs.2024.01.110
12. Lupi, Francesco, et al. "Automatic definition of engineer archetypes: A text mining approach." Computers in Industry, Volume 152, 103996 (2023), https://doi.org/10.1016/j.compind.2023.103996
13. Lupi, Francesco, et al. "Ontology for Constructively Aligned, Collaborative, and Evolving Engineer Knowledge-management Platforms ." Casalino, G., et al. Higher Education Learning Methodologies and Technologies Online. HELMeTO 2023. Communications in Computer and Information Science, vol. 2076, https://doi.org/10.1007/978-3-031-67351-1_10

14. Bonello, Amberlynn, et al. "Beyond the pandemic: How has Covid-19 shaped the capability to adopt an Agile Blended Learning in HEI?" 5th International Conference on Higher Education Learning Methodologies and Technologies Online - Book of Abstracts. Foggia, Italy, 2023, p. 29-30, ISBN: 978-88-99978-64-8, LINK
15. Antonelli, Dario, et al. "Introducing sustainability themes in STEM education: evidences from some European countries." 4th International Conference on Higher Education Learning Methodologies and Technologies Online HELMeTO2022, September 21-23, 2022, Palermo, Italy, Book of Abstracts, p. 312-314, LINK
16. Maffei, Antonio; Antonelli, Dario; Stylios, Chrysostomos "Overcoming the obstacles hindering the application of Virtual Reality to e-learning." HELMeTO 2021 Third International Workshop on Higher Education Learning Methodologies and Technologies Online, ISBN 978-88-99978-36-5, LINK