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Blended Learning Implementation for reSilient, acceSsible and efficient higher education

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

Project result 5 - Deliverable 5.1.1 – A survey of environment specific reasons for performance deterioration

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Document heading

Project title:	Blended Learning Implementation for reSilient, acceSsible and efficient higher education
Project result:	5
Leading org.:	University of Ljubljana
Output title:	Cross-application of educational units among the partners
Authors:	University of Ljubljana with input from the entire consortium

Project Deliverable 5.1.1 summary:

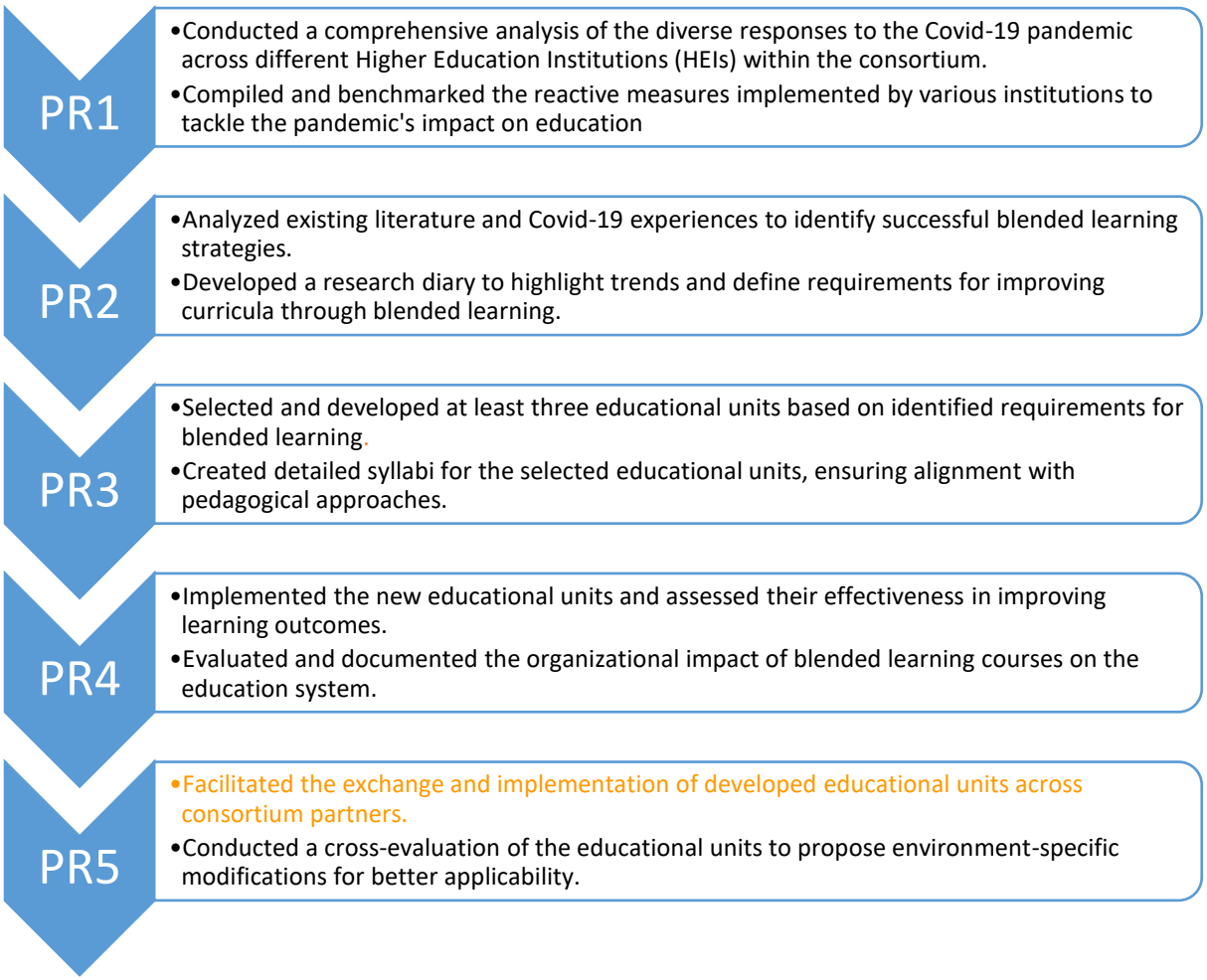
Project deliverable implementation

Project result 5 was divided in two tasks. The first one was titled: “Cross evaluation of the developed blended learning educational units by partners throughout the partnership.”. With this approach we were able to obtain the information on how each educational unit performed in other environments. Each partner had to report how the educational units developed by other partners, perform in his specific environment together with the reasons for possible deterioration.

Division of work

Each partner provided the feedback with the assessment of difficulties that educational units meet when transferred into his environment together with the specific reason. The results of the feedback were collected by University of Ljubljana who then presented the aggregated results.

Project Deliverable 5.1.1 in the context of the project



Detailed results of the activities

Context

One of the main results of the project is the assessment of applicability of educational units outside the partner institutions which developed them. In order to have a better idea of the applicability of the developed educational units beyond the project partnership, project partners were asked to assess the applicability of each educational unit at their institution. The aspects which were considered were:

1. *Laboratories*
   Partners were asked about the availability of lab facilities and/or special purpose classrooms needed for the implementation of the educational unit.
2. *Personnel*
   Partners were asked about the availability of personnel needed to conduct the lectures/lab exercises (professors, teaching assistants, skilled lab technicians and (if needed) alumni from the industry.
3. *Material*
   Partners were asked about software and hardware availability needed for the educational unit implementation, as well as other equipment that might be needed (microcontroller, robots, etc.)
4. *Resources*
   Partners were asked about the availability of financial resources needed for the implementation of the educational unit.
5. *Other*
   In this field partners were asked to assess the applicability of the educational unit from any other aspect that the partner who developed it planned (possible industrial partners, planned company visits, etc.)

Partner feedback

The partners were instructed to provide the data in the form of an Excel file with visual input (color) outlining the assessed availability (green meaning full availability, orange meaning partial availability and red no availability) and/or textual input specifying the possible problems in more detail (see the attached files for details).

Results

The following comments regarding the developed educational units were given by the partners:

1 University of Bergamo, Course on Operation Management

ILO 1: Describe business processes in the operations management domain and illustrate them using BPMN2.0

Comments:
UNIBG: /

UNILJ: A minor personnel problem was indicated regarding the support needed during the simulation part of the class. Extra workforce would be required for it, which also needs to get acquainted by BPMN 2.0 modelling software, as it is currently not available.
UNIMA: A minor personnel problem was indicated due to high number of students attending the course. As a consequence, additional workforce would be needed to handle everything. The problem is however that specific knowledge regarding the software is needed. The unavailability of BPMN 2.0 was pointed out as a significant problem. Not only from the point of view of teaching, but also from the point of view of assessment activities.
UNIRI: The requirement for laptops was pointed out to be a significant problem. Minor personnel problem was indicated as new workforce would have to be hired. The requirement for BPMN 2.0 modelling software was also indicated to be a minor problem.
POLITO: No problems foreseen.
KTH: Minor problem indicated due to the required transition from Moodle to Canvas.

ILO 2: Produce discrete event simulation models of business processes in the operations management domain with AnyLogic, and analyze and compare their performance

UNIBG: /
UNILJ: A minor personnel problem was indicated regarding the support needed during the simulation part of the class. Extra workforce would be required for it, which also needs to get acquainted by AnyLogic software, as it is currently not available.
UNIMA: A minor personnel problem was indicated due to high number of students attending the course. As a consequence, additional workforce would be needed to handle everything. The problem is however that specific knowledge regarding the software is needed. The unavailability of AnyLogic was pointed out as a significant problem. Not only from the point of view of teaching, but also from the point of view of assessment activities.
UNIRI: The requirement for laptops was pointed out to be a significant problem. Minor personnel problem was indicated as new workforce would have to be hired. The requirement for AnyLogic software was also indicated to be a minor problem.
POLITO: No problems foreseen.
KTH: Minor problem indicated due to the required transition from Moodle to Canvas.

2 University of Ljubljana, Discrete Control Systems

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

UNIBG: Personnel problems as both lab technician and assistant would be required. It was also pointed out that additional microcontrollers would have to be bought.
UNILJ: /
UNIMA: It was pointed out (as a significant problem) that lab work cannot be used in assessment process. A minor personnel problem was indicated due to large number of students who have to be divided in groups and supervised, so additional workforce would be needed. A significant problem is also the unavailability of both Arduino microcontrollers (National Instruments software is used instead) and the appropriate lab facilities.
UNIRI: Minor personnel problem was indicated as supervising multiple student groups, each working on an Arduino project, can be overwhelming for a single teacher. A significant problem is a very limited availability of Arduino microcontrollers.

POLITO: Minor personnel problem was indicated as supervision of multiple groups would imply hiring of new assistant and lab technician. Limited availability of Arduino microcontroller was also pointed out as a minor problem.
KTH: Minor problem indicated due to the required transition from Moodle to Canvas. Minor personnel problem was also indicated when the most suitable professor retires. Significant problem regarding the requirement of Arduino microcontrollers as they would need to be bought.

3.a University of Malta, Quality and Reliability Engineering

ILO 1: Remember and understand the theoretical and background knowledge of Six-sigma process improvement methodologies.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Operations management or quality management"
UNILJ: No problems foreseen.
UNIMA: /
UNIRI: Significant personnel problem indicated as there are no six-sigma related topics in the study program.
POLITO: Significant personnel problem was indicated as there is no similar course organized at Polito.
KTH: No problems foreseen.

ILO 2: Apply the Six-Sigma process improvement methodologies to an engineering case study.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Operations management or quality management"
UNILJ: No problems foreseen.
UNIMA: /
UNIRI: Significant personnel problem indicated as there are no six-sigma related topics in the study program.
POLITO: Significant personnel problem was indicated as there is no similar course organized at Polito.
KTH: No problems foreseen.

ILO 3: Present and defend the findings which will be discussed in class and criticize the other group's findings.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Operations management or quality management"
UNILJ: No problems foreseen.
UNIMA: /
UNIRI: Significant personnel problem indicated as there are no six-sigma related topics in the study program.
POLITO: Significant personnel problem was indicated as there is no similar course organized at Polito.
KTH: No problems foreseen.

3.b University of Malta, Artificial Intelligence in Engineering

ILO 1: Explain the basic structure and functions of Artificial Neural Networks.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Operations management or quality management"
UNILJ: No problems foreseen.

UNIMA: /
UNIRI: No problems foreseen.
POLITO: No problems foreseen.
KTH: No problems foreseen.

ILO 2: Apply an Artificial Neural Network to solve a classification problem.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Operations management or quality management"
UNILJ: No problems foreseen.
UNIMA: /
UNIRI: No problems foreseen.
POLITO: No problems foreseen.
KTH: No problems foreseen.

ILO 3: Compare the application of Artificial Neural Networks to the K-Nearest Neighbours Algorithm for a classification problem.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Operations management or quality management"
UNILJ: No problems foreseen.
UNIMA: /
UNIRI: No problems foreseen.
POLITO: No problems foreseen.
KTH: No problems foreseen.

4 University of Rijeka, Human-Computer Interaction

ILO 1: Select and apply appropriate statistical tests on data obtained from a HCI experiment, and derive the conclusions according to their outcomes.

UNIBG: Significant personnel problem indicated as there is no similar course offered at UNIBG.
UNILJ: No problems foreseen.
UNIMA: No problems foreseen.
UNIRI: /
POLITO: No problems foreseen.
KTH: Minor problem indicated regarding which professor might be the most suitable for lecturing this educational unit.

5 Politecnico Torino, Production Systems (Management engineering)

ILO 1: The student will be able to outline and express with mathematical models the technological properties of the materials used for production

UNIBG: Significant personnel problem indicated as there is no similar course offered at UNIBG.
UNILJ: Significant personnel problem indicated as the provided videos are only in Italian. Percentage of personnel able to understand it is very low. Minor problem is also the requirement of a locked-down browser.
UNIMA: Minor personnel problem was indicated as additional staff would needed to be hired in order to handle all the students. Significant problem was indicated regarding the assessment part of the

course as UNIMA is using WiseFlow in order to carry out the remote exams. Integration with Lock-down might be problematic.
UNIRI: Minor personnel problem indicated regarding the acquisition of the most suitable professor. Significant problems are both the requirement of Lockdown browser and the availability of videos in only Italian.
POLITO: /
KTH: Significant problem is the availability of the course material only in Italian. The requirement of the LockDown browser is also indicated as a problem, as well as the needed transition from Moodle to Canvas.

ILO 2: The student will dimension a given manufacturing process, calculate the technical and economic performances and taking into account quality, safety and sustainability issues.

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Industrial plant design"
UNILJ: Significant personnel problem indicated as the provided videos are only in Italian. Percentage of personnel able to understand it is very low. Minor problem is also the requirement of a locked-down browser.
UNIMA: Minor personnel problem was indicated as additional staff would needed to be hired in order to handle all the students. Significant problem was indicated regarding the assessment part of the course as UNIMA is using WiseFlow in order to carry out the remote exams. Integration with Lock-down might be problematic.
UNIRI: Minor personnel problem indicated regarding the acquisition of the most suitable professor. Significant problems are both the requirement of Lockdown browser and the availability of videos in only Italian.
POLITO: /
KTH: Significant problem is the availability of the course material only in Italian. The requirement of the LockDown browser is also indicated as a problem, as well as the needed transition from Moodle to Canvas.

ILO 3: The student will be able to choose, integrate and deploy the manufacturing steps as a coordinate system oriented to the making of an industrial product (process plan)

UNIBG: Minor personnel problem indicated, but could be solved by a course candidate "Industrial plant design"
UNILJ: Significant personnel problem indicated as the provided videos are only in Italian. Percentage of personnel able to understand it is very low. Minor problem is also the requirement of a locked-down browser.
UNIMA: Minor personnel problem was indicated as additional staff would needed to be hired in order to handle all the students. Significant problem was indicated regarding the assessment part of the course as UNIMA is using WiseFlow in order to carry out the remote exams. Integration with Lock-down might be problematic.
UNIRI: Minor personnel problem indicated regarding the acquisition of the most suitable professor. Significant problems are both the requirement of Lockdown browser and the availability of videos in only Italian.
POLITO: /
KTH: Significant problem is the availability of the course material only in Italian. The requirement of the LockDown browser is also indicated as a problem, as well as the needed transition from Moodle to Canvas.

6 KTH, Scientific Methodology for Production Engineering

ILO 1: The student will be able to outline and express with mathematical models the technological properties of the materials used for production

UNIBG: Significant personnel problem indicated as there is no similar course offered at UNIBG. An indicated minor problem is also unavailability of Zoom at UNIBG.
UNILJ: No problems foreseen.
UNIMA: No problems foreseen.
UNIRI: Minor personnel problem indicated regarding the acquisition of the most suitable professor.
POLITO: Significant personnel problem indicated as there is no similar course offered at Polito.
KTH: /

For an easier (visual) interpretation of results and aggregate table of the educational unit performance is given below.

Legend:

L – laboratories	e.g. lab facilities, special purpose classrooms
P – personnel	e.g. professors, teaching assistants, skilled lab technicians, alumni from industry
M – material	e.g. robots, special purpose software
R – resources	e.g. financial
O – Other	e.g. industrial partners, company visits
Course	
	fully available
	partially available
	not available

University of Bergamo

Course details:

Operations Management (OM)
- graduate program in Management Engineering
- English / Italian
- In class (not obligatory), students have laptops, teaching assistant / co-prof walks along the room; exam in the lab (laptop + paper)

ILO1 / UNIBG Describe business processes in the operations management domain and illustrate them using BPMN2.0		**ILO2 / UNIBG** Produce discrete event simulation models of business processes in the operations management domain with AnyLogic, and analyze and compare their performance	
L		L	
P	Extra workforce required	P	Extra workforce required

M	BPMN 2.0 modelling software, and the requirement for laptops. One partner mentioned a need for transition from Moodle to Canvas	M	AnyLogic software, and the requirement for laptops. One partner mentioned a need for transition from Moodle to Canvas
R		R	
O		O	

University of Ljubljana

Course details:

Discrete Control systems (ILO1)
- undergraduate program in Mechanical Engineering (Mechatronics)
- lectures and lab exercises where students are divided in groups and work on Arduino microcontrollers

ILO1 / UNILJ 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	
L	
P	All the partners indicated a minor personnel problem due to the requirement of students being supervised when working in groups in the lab.
M	The requirement for Arduino microcontrollers was pointed out to be a major problem as some of the partners either don't have them or their availability is limited.
R	
O	

University of Malta

Course details:

Quality and Reliability Engineering
- Presentations, SCORM objects via LMS, case studies (group projects, 4 students involved)

ILO1 / UNIMA Remember and understand the theoretical and background knowledge of Six-sigma process improvement methodologies.		**ILO2 / UNIMA** Apply the Six-Sigma process improvement methodologies to an engineering case study.		**ILO3 / UNIMA** Present and defend the findings which will be discussed in class and criticize the other group's findings.	
L		L		L	

P	The whole spectrum of answers was obtained but minor problem is an average. Two partners have no problems. One sees it as a minor problem. Two indicated significant problem as they don't have a similar course in their study program.	P	The whole spectrum of answers was obtained but minor problem is an average. Two partners have no problems. One sees it as a minor problem. Two indicated significant problem as they don't have a similar course in their study program.	P	The whole spectrum of answers was obtained but minor problem is an average. Two partners have no problems. One sees it as a minor problem. Two indicated significant problem as they don't have a similar course in their study program.
M		M		M	
R		R		R	
O		O		O	

Course details:

Artificial Intelligence in Engineering
- Presentations, SCORM objects via LMS, individual assignments, Google Colab for joint-work prof-student

ILO1 / UNIMA Explain the basic structure and functions of Artificial Neural Networks.		**ILO2 / UNIMA** Apply an Artificial Neural Network to solve a classification problem.		**ILO3 / UNIMA** Compare the application of Artificial Neural Networks to the K-Nearest Neighbours Algorithm for a classification problem.	
L		L		L	
P	Just one partner suggested a minor problem finding the lecturer.	P	Just one partner suggested a minor problem finding the lecturer.	P	Just one partner suggested a minor problem finding the lecturer.
M		M		M	
R		R		R	
O		O		O	

University of Rijeka

Course details:

Human-Computer Interaction
- presentations, mock-up cases descriptions and data, supplementary learning materials (pdf documents, web links), a rubric, statistical software - arbitrarily (Python libraries included)

ILO1 / UNIRI Select and apply appropriate statistical tests on data obtained from a HCI experiment, and derive the conclusions according to their outcomes.	
L	
P	Three partners have no problems. One partner has minor problem finding the right lecturer and one sees it as a significant problem as they have no similar course in the study program
M	
R	
O	

Politecnico di Torino

Course details:

Production Systems (Management engineering)
- EdUNIT: Materials Science Fundamentals, and Engineering Properties
- LMS (learning material, problem sets, exercises, quizzes); video lectures and pdfs available, exam in lab (or via PC)

ILO1 / POLITO The student will be able to outline and express with mathematical models the technological properties of the materials used for production		**ILO2 / POLITO** The student will dimension a given manufacturing process, calculate the technical and economic performances and taking into account quality, safety and sustainability issues		**ILO3 / POLITO** 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)	
L		L		L	
P	The majority of partners have either significant or minor problem. There are two causes. The first one is that videos are only available in italian, and the second one is they don't offer a similar course.	P	The majority of partners have either significant or minor problem. There are two causes. The first one is that videos are only available in italian, and the second one is they don't offer a similar course.	P	The majority of partners have either significant or minor problem. There are two causes. The first one is that videos are only available in italian, and the second one is they don't offer a similar course.
M	Four out of five partners see the Lockdown software requirement for the exam as a problem. Two see it as significant and two as a minor problem.	M	Four out of five partners see the Lockdown software requirement for the exam as a problem. Two see it as significant and two as a minor problem.	M	Four out of five partners see the Lockdown software requirement for the exam as a problem. Two see it as significant and two as a minor problem.
R		R		R	
O		O		O	

KTH

Course details:

Scientific Methodology for Production Engineering
- Research and debate online
- Preparing debate using chatgpt
- 3 two-person pairs (affirmative, negative, evaluate)

ILO1 / KTH Gather information and elaborate a strategy to qualify and defend an opinion on a controversial topic, and analyse and summarize the consequent debate	
L	
P	One partner suggested minor problem finding the right professor and two significant problem as they don't offer a similar course.
M	
R	
O	

Conclusion

The results of the cross-evaluation clearly show that transferring educational units to another environment is not such a straightforward approach. The main difficulties identified within the partnership seem to be related to personnel and material**.** The question “How to address these difficulties?” is the topic of Task 5.2 within the same project result.

Attachments

The files containing detailed feedback from each of the partners.

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
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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