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Virginie Siret, Laurent Tabourot, Christine Galez, Marina Zingraf, Miruna Peris, Alexandru Oarcea

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Erasmus+ Strategic Partnerships for higher education

CROSSING BORDERS: PEER-TO-PEER EDUCATION IN MECHATRONICS

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Abstract

The Erasmus+ project entitled XP2P (crossing borders: peer to peer education in mechatronics) was developed through the collaboration of the University of Applied Sciences Kaiserslautern (HSKL), the Technical University of Cluj-Napoca (TUCN) and the University Savoie Mont Blanc (USMB).

The aim of the XP2P-project is to implement peer-to-peer learning during a whole semester or a module for post-graduate students in mechatronics, connected to the implementation of a suitable Competency Portfolio Assessment for guidance and documentation of the students' progress. Thanks to collaborative projects proposed by partners' staff or by their partner companies, project-based learning in combination with this innovative approach using peer-to-peer learning should allow the students to acquire improved cross-functional skills.

Mechatronics is usually defined as a synergistic and integrated process of several sciences and skills (among which control science, computer science, electronics and mechanics).

This document corresponds to the Intellectual Output no. 4 of the XP2P project. It consists of the proposal of a semester or module-based curriculum for Master programmes in Mechatronics, based on peer learning combined with project- and competency-based learning.

Within each partner university, the teaching teams involved in the project have implemented peer learning in combination with a competency-based approach in teaching methods and the use of an eportfolio in the framework of several courses of their master's programmes. During the first run (winter 2020/2021), the impacted courses dealt essentially with mechatronics while during the second run (2021/2022), the process has been extended to other domains. Regular online meetings allowed the partners to discuss and overcome difficulties and to share experiences and feedback to enrich the implementation of the eportfolio for the student.

This has been achieved through the use of different learning management system platforms and collaborative working tools. However, the Mahara platform to implement the eportfolio was the common platform for the 3 universities.

The Bologna process requires higher education to focus more on the acquisition of competencies¹. The XP2P project was thus an opportunity to introduce the competency approach using peer learning, project-based learning and eportfolio in postgraduate courses in Mechatronics in 3 master programmes of 3 European universities. The corresponding teaching teams worked collaboratively to continuously improve the quality of the teaching offered to their students in order to achieve success.

The Covid-19 crisis was an additional challenge to face during most of the project. This was indeed a hindrance to face-to-face meetings and exchanges between students, but the teaching teams were able to implement workarounds to allow optimal learning for the students and to implement the competency-based approach in their teaching practices.

From our experience, it seems that the collaboration and the active and motivated involvement of several actors are necessary for the implementation of innovative teaching methods to be successful for the students, especially in a multicultural and European project.

On the basis of this experience, we believe that the deployment of this approach must be based on a strategic vision of the different universities in the European space, particularly with regard to their competences in the field of valuing students' learning.

¹ Stratmann, J., Preussler, A., Kerres, M. (2009). Lernerfolg und Kompetenz: Didaktische Potenziale der Portfolio-Methode im Hochschulstudium. Zeitschrift für Hochschulentwicklung, 4(1).

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Foreword

The XP2P project

Mechatronics is usually defined as a synergistic and integrated process of several sciences and skills (among which control and computer sciences, electronics, mechanics). It allows the conception of products and systems with augmented or improved functionality, and it requires to consider the conception of the product or system in its overall lifecycle in a cooperative interdisciplinary approach.

The aim of the XP2P-project is to implement peer-to-peer learning during a whole semester or a module for post-graduate students in mechatronics, connected to the implementation of a suitable Competency Portfolio Assessment for guidance and documentation of the students' progress. Thanks to collaborative projects proposed by partners' staffs or by their partner companies, project-based learning in combination with this innovative approach using peer-to-peer learning will allow the students to acquire improved cross-functional skills such as:

- social skills (coordinating with others, negotiation, persuasion, training and teaching others),
- resource management skills (management of materials resources, time management),
- systems skills (judgement and decision-making, systems analysis),
- technical skills.

With the student-centred learning methods implemented in the XP2P project, peer-to-peer learning can act as a motivational instrument to gradually enhance the interest of current and future engineering students in mechatronics.

Peer-to-peer learning takes place between master's students themselves as they originate from different scientific backgrounds (mechanics, electronics, control science, computer science, mechatronics) and from different countries. 30 ECTS are allotted to the semester, 10 to 20 ECTS being devoted to peer-to-peer learning (10 ECTS for HSKL and UTCN, and 20 ECTS for USMB). Peer-to-peer learning takes place in every learning mode and uses digital platforms such as Moodle and OLAT.

Linked to this aim, our objective is first the integration of didactic tools and methods in the context of peer-to-peer teaching and learning through project-based learning, customization of learning pathways and their corresponding teaching and assessment methods as well as the definition of the corresponding relevant reference competency framework in mechatronics.

We identified 3 target groups in our project:

- the master students in mechatronics involved in this programme who will gain skills and competencies positive for their employability and for their potential employers.
- involved teaching staff who will increase their teaching skills by facing this challenging way of student-centred teaching method and by working in a crossed environment: several disciplines and students from different countries with different backgrounds and "student cultures".
- employers and laboratories who will benefit from the increased competencies of graduated students in complex and collaborative problem solving.

The international perspective is necessary to implement and validate different ways of teaching and of learning and to obtain generic results, transferable in other higher education institutions.

Through the project, the involved partners gained expertise in mechatronics peer-to-peer teaching and aimed at sharing the results of the XP2P-project into the academic community, via the Intellectual Outputs and multiplier events of the XP2P project.

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Partners

With 15,000 students, a wide range of courses and 18 research laboratories, the Savoie Mont Blanc University (USMB) is a human-sized institution that combines proximity to its territories and a wide opening onto Europe and the world. It offers short courses (University Degrees) and long courses degrees (Bachelor's, Master's, Doctorate and Engineering Degrees), whether in initial training, continuing education, work-linked training or accreditation of prior experiential learning (*Validation des acquis de l'expérience* or VAE)².

The engineering school Polytech Annecy-Chambéry is part of the Savoie Mont Blanc University and the Polytech network. It offers engineering degrees as well as Master's degrees. It trains 1 100 engineering students and includes 90 teacher-researchers, 105 instructors from companies, 53 administrative and technical staff, 4 900 alumni and 3 research laboratories.

The Master's degree in Complex Systems Engineering offers a single curriculum entitled Advanced Mechatronics (AM). It is an international and research-oriented curriculum. Mechatronics is a process integrating in synergy several sciences and skills (electronics, mechanics, control science and computer science), which allows to imagine and design products and systems offering increased or improved functionality. This requires placing the design of the product or system within its overall life cycle and adopting a cooperative interdisciplinary approach.

The aim of this course is to enable students to imagine, design, implement and operate a Mechatronic system or product in the context of research projects or R&D projects and to prepare them for a doctoral degree course.

Graduates can then continue their doctoral studies, work as a senior manager in public or private R&D centres and hold high-level technical and scientific positions in specialised engineering offices.

The Master's degree is mainly based on the [SYMME laboratory](#) and draws on the activities of the two other laboratories at Polytech Annecy-Chambéry [LISTIC](#) and [LOCIE](#).

Polytech Annecy-Chambéry has set up many international relations, and it is in this context that the teaching team of the Master's degree has decided to work with the Hochschule Kaiserslautern - University of Applied Sciences and the Technical University of Cluj-Napoca, two German and Romanian universities that also offer a Master's degree in mechatronics.

The Technical University of Cluj-Napoca is a higher education institution with 12 faculties in the two university centres, Cluj-Napoca and Baia Mare, as well as in Alba-Iulia, Bistrita, Satu Mare and Zalau, where more than 900 academic staff and more than 22,000 students work³.

The educational offer, in line with the Bologna system, includes Bachelor, Master and Doctorate degree courses as well as continuing education programs.

The fields of study range from engineering to architecture, basic sciences, life and health sciences, environmental sciences, social sciences and humanities. The Technical University of Cluj-Napoca is open to the European and global space of education and research through a constant process of internationalisation.

² Université Savoie Mont Blanc. (s. d.). Découvrir l'USMB. Consulté le 14 mai 2020, sur <https://www.univ-smb.fr/universite/decouvrir-lusmb/>

³ Université Technique de Cluj-Napoca. (s. d.). L'Université technique aujourd'hui. Consulté le 14 mai 2020, sur <https://www.utcluj.ro/fr/universite/sur/aujourd'hui/>

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The Hochschule Kaiserslautern is a medium sized university of applied sciences offering courses in engineering, business, design, health and computer science. Around 6300 students from more than 80 different countries study with the support of 150 professors and 450 technical and non-technical staff in more than 60 undergraduate and graduate programs⁴.

The Hochschule Kaiserslautern was the first University of Applied Sciences in its federal state to become "accredited". Its focus on research was especially recognized and the University is now recognized as a project leader in the prestigious German "Innovative Hochschule" program.

⁴ Hochschule Keiserslautern University of applied sciences. Hochschule Kaiserslautern - from the region, for the region, into the world. Consulté le 14 mai 2020 sur <https://www.hs-kl.de/en/university/profile/university-portrait>

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Introduction

This document corresponds to the Intellectual Output no. 4 of the XP2P project. It consists of the proposal of a semester or module-based curriculum for Master programmes in Mechatronics, based on peer learning combined with project- and competency-based learning.

Contrary to what was originally envisaged in the preparation of the project, it was not possible to set up transnational exchanges between the students of the project partners, either in real or virtual mobility, as the situation was particularly affected by the Covid-19 pandemic from March 2020.

The following pedagogical practices were implemented through the project and were understood as follows.

- Peer-to-peer education refers to learning with and from each other. In peer-to-peer education, the focus shifts to the student learning process. Students share their learning experiences in interaction with each other and through mutual support⁵.
- Competency-based approach is “a new way of planning teaching and learning in a curriculum to support the development of competencies. Competences, conceived as complex knowing how to act, integrate a relatively large set of resources: knowledge, know-how, interpersonal skills, tools, etc. Their development results from a gradual and progressive integration of these resources in authentic situations derived from professional life or research activities”⁶. It implies a new “way of organising training which consists in placing competencies (and not only knowledge and skills) at the heart of the teaching-learning systems”⁷.
- Students’ e-portfolios are digital collections created to assess learning progress and which contain multimedia evidence of students’ efforts and competences. The e-portfolio not only checks the extent to which knowledge has been absorbed, but also shows in particular how this knowledge is handled (see the documents of the XP2P project corresponding to Intellectual Outputs 3 and 5 for further information).
- Project-based learning is an active pedagogical method that enables students to learn by carrying out concrete projects⁸. These projects involve challenging and authentic tasks that relate to real work situations^{9,10} and take place over an extended period of time¹¹.

The expected effects of the didactic methods implemented are:

- a more responsible and active role for students in managing their studies
- the acquisition of transversal skills by students who will be used to social interaction with people from different cultural and scientific backgrounds

⁵ Boud, D. (2001). Making the move to peer learning. In *Peer Learning in Higher Education: Learning from and with each other* (Boud, D., Cohen, R. & Sampson, J. (Eds.), p. 1-20). London: Kogan Page (now Routledge).

⁶ Approche par compétences / Qu’est-ce que l’approche par compétences ? Centre de pédagogie universitaire - Université de Montréal. <https://cpu.umontreal.ca/expertises/approche-par-competences/>

⁷ Jonina R., Sauter C., Kennel S., 2019. Livret : Formaliser une compétence dans un référentiel de compétences selon le modèle de Jacques Tardif. Institut de Développement et d’Innovation Pédagogiques, Université de Strasbourg. Document non publié, développé dans le cadre du projet ADCES – Accompagner le Développement des Compétences dans l’Enseignement Supérieur (<https://adces.unistra.fr/wp-content/uploads/2021/10/Livret-tardif.pdf>)

⁸ Perrenoud, P. (1999). Apprendre à l’école à travers des projets : pourquoi ? Comment ? Faculté de psychologie et de sciences de l’éducation, Université de Genève, http://www.unige.ch/fapse/SSE/teachers/perrenoud/php_main/php_1999/1999_17.html

⁹ Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving schools*, 19(3), p. 267-277. <https://doi.org/10.1177/1365480216659733>

¹⁰ Solomon, G. (2003). Project-Based Learning: a Primer. *Technology and Learning-Dayton*, 23(6), p. 20

¹¹ Gary, K. (2015). Project-based learning. *Computer*, 48(9), p. 98-100, <https://doi.org/10.1109/MC.2015.268>

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- the acquisition of complex problem solving and collaborative problem-solving skills by students, who will be able to develop their "learning agility" to cope with any subsequent non-routine multidisciplinary task in their career

Thus, this should bring young mechatronic graduates with the required knowledge and skills into the labour market. It should also enable the teaching staff to adopt a student-centred pedagogy and to implement peer learning in their practice.

The results should be transferable to any mechatronics programme and more generally to any engineering programme with some adaptations.

Further information can be found in the documents of Intellectual Outputs 1, 2, 3 and 5 which can be downloaded from the project website: <https://xp2p-project.eu/>.

The Intellectual output 1 provides a review and mapping of research related to peer learning. In order to visualise the evolution over time of the peer learning method and to identify the current stage of this modern method, a graphical representation based on the scientific articles published each year from 1996 to 2020 is proposed. The benefits of peer learning for individuals are also identified from the information reported in the most relevant scientific articles. Among the main benefits of this innovative method, we could highlight: the development of organisational skills, critical thinking and problem solving, greater flexibility in interaction, as well as the reduction of stress and anxiety of individuals.

The Intellectual Output 2 gives an overview of the methods in peer learning implemented within the master's students of the XP2P project partners, as well as information about the feedback collected from the involved students and teaching staff.

The Intellectual Output 3 consists of a handbook to implement peer-to-peer learning in engineering studies (using the example of mechatronics). The handbook is one of the central elements of the XP2P project that makes the collected results available in the long term. It was the intention of the project partners to create a practical guide to disseminate the challenges and successes experienced. Ideally, it should be shared as a platform by us and others interested in P2P learning. Since a complete shift to peer-to-peer education is likely to be too radical for most colleagues, information is also provided on practical ways to implement it partially. The main part of the manual refers to the three central elements of the XP2P project: peer-to-peer learning, e-portfolio method and competency-based learning. Note that the chapters referring to these main topics can be read independently of each other. The final part of the manual refers to the practical implementation within the XP2P project. Two examples illustrate how the three central content elements could be linked and implemented within 2 courses. Thus, an overview of the planning and implementation is given, insights into the feedback on the implementation of the methodology are presented and suggestions for improvement and implementation are given. The aim of the handbook is to meet the needs of the readers: they can independently choose which areas of the XP2P project they want to immerse themselves in and the intensity with which they want to deal with them.

The document related to the Intellectual Output 5 is focused on the competence e-portfolio concept and its assessment. Thus, it develops a framework for the structure and the contents to be documented in the competence e-portfolio. A basic definition of e-portfolios based on the current state of research on e-portfolios in higher education is formulated, which combines both the demands of higher education and the objectives of the XP2P project. Then, the didactic requirements for e-portfolios are examined. Finally, based on the didactic findings from the literature work, the necessary results for the XP2P project

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are presented: the e-portfolios, the didactic concept including the required contents of the e-portfolio and a general competence framework.

The present document describes the contexts within the project partner institutions, reminds their objectives and describes the practical implementation of peer learning activities with their master's students in mechatronics throughout the XP2P project through several illustrative examples.

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I. Practical implementation of peer learning semester/module in the master in Advanced Mechatronics at USMB

I.1. Description of the context and of the overall organisation implemented

I.1.1. Public definition

The students involved in the XP2P project were enrolled in the master's programme in Complex Systems Engineering – Advanced Mechatronics. The number of participants per class has been set at around 20 students in order to ensure an efficient, personalised and regular follow-up as the programme is largely built on problem-based learning.

Access to the Master's programme in Advanced Mechatronics at USMB is described as follows.

The M1 (first year) is open to holders of a national diploma conferring a Bachelor's degree or equivalent in a field of study compatible with that of the Master's degree, and to candidates who have received a validation of prior learning, after examination of the file. The recommended bachelor's degrees for access to the AM Master's degree are: Engineering Sciences, Science and Technology, Electronics - electrical energy - control science, Mechanics, Information Technology, Physics, Physics – chemistry.

The M2 (second year) is open to candidates who have validated, in the same discipline, a 1st year of a national degree conferring the degree of master or a 1st year of a postgraduate degree if it corresponds to the level of studies required, as well as to candidates who have a validation of prior learning.

The headmaster on the proposal of the recruitment committee decides admission to M1 and M2 after examination of the application files.

Graduates may pursue doctoral studies, work as senior managers in public or private R&D centres and occupy high-level technical and scientific positions in specialised design offices.

The nine students of semester 9 (Master 2) for the year 2020/2021 came from Algeria, Egypt, India, France and Lebanon. They were between 22 and 29 years old and had multiple disciplinary backgrounds: electronics, electrical energy, home automation, mechanical engineering.

The eleven students of semester 9 (Master 2) for the year 2021/2022 came from Algeria, India, France, Lebanon, Mexico, Morocco, Spain and Tunisia. They were between 22 and 32 years old and had multiple disciplinary backgrounds: electronics, electrical engineering, home automation, mechanical engineering, mechatronics, industrial engineering and maintenance

I.1.2. Team involved in the project

In order to ensure an effective follow-up of each participant, at least one teacher is responsible for the different Course Units (CU) for which they constitute the teaching resources and activities and ensures the follow-up of the students.

The pedagogical team is made up as follows:

- Christine Galez (Polytech Annecy-Chambéry), training manager,
- Laurent Tabourot (Polytech Annecy-Chambéry),
- Camilo Hernandez-Rodriguez (Polytech Annecy-Chambéry),
- Frédéric Gillardo (CNRS – LAPP, high energy physics laboratory),
- Ludovic Charleux (Polytech Annecy-Chambéry),
- Paméla Dupré (Polytech Annecy-Chambéry),
- Jean-Jacques Curtelin (administrator of the distance-learning platform of Polytech Annecy-Chambéry).

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The teachers working in the different CUs ensure, beyond the transmission of knowledge, a proactive and reactive disciplinary tutoring.

A seminar was proposed in June 2020 by Christine Galez, project leader, to present the XP2P project to the USMB teaching staff and to exchange information about it.

Training on the tools of the LMS (Learning Management System) Moodle platform was proposed to the teaching team of the master's programme in June 2020, in order to upgrade the teachers' knowledge and skills and work about specific activities allowing peer learning, competency approach and project-based pedagogy. Pedagogical engineers from the USMB "Apprendre" department conducted this training (the "[Apprendre](#)" department at USMB supports and accompanies teaching teams in the evolution of teaching for the success of students).

I.1.3. Description of the semester

The master's programme in Advanced Mechatronics (master AM) is aimed at students from different disciplines and countries who wish to acquire the technical and cross-disciplinary skills necessary to become executives in the Mechatronics sector.

Semester 9 of the master offers face-to-face learning (lectures, tutorials and practicals) as well as distance learning via Polytech or USMB distance-learning platforms (resources and activities accessible on the Moodle and Mahara platforms). Deployed from mid-September to the end of January (~17 weeks), it represents a total of 30 ECTS and is made up of face-to-face learning estimated at 74 hours (if there is no lockdown due to an outbreak!), distance learning estimated at 50 hours. The students are involved in two collective projects and one individual project for about 500 hours.

Peer learning within the training scheme represents 20 ECTS and is spread over the semester, which is composed of 3 teaching units (TU).

The acquisition of knowledge and skills during the training covers the following themes:

- embedded systems and supervision (13 ECTS),
- rights, ethics and scientific dissemination (9 ECTS),
- preparation for doctoral studies (8 ECTS).

Innovative and motivating pedagogical methods, based in particular on learning construction, peer learning, competency-based approach and project-based pedagogy, are combined with regular and personalised monitoring by the teachers involved in each of the CUs.

I.1.4. Learning objectives

◆ **Disciplinary skills and knowledge**

The main objective of this scheme is to contribute to the acquisition by participants of specific skills and knowledge to pursue doctoral studies, to work as senior managers in public or private R&D centres or to occupy high-level technical and scientific positions in specialised design offices.

The objective of this master's degree is to enable students to imagine, design, implement and operate a mechatronic system or product within the framework of research or R&D projects and to prepare them for a doctoral track. This requires the relevant knowledge, skills and attitudes including an understanding of the fundamentals of the disciplines, understanding of design and manufacturing processes, the ability to take a multidisciplinary view of the product or system, to work in an integrative way, to possess good communication skills and a high degree of ethics (Figure 1) in order to:


- design and achieve a mechatronic system,

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- manage a research project,
- master the expectations of research.

The training system is proposed with a competency-based approach; it must therefore enable each student to acquire the know-how to act, resulting from the integration of a set of capacities, skills (which may be cognitive, affective, psychomotor or social) and knowledge.

In order to achieve the main objective of the training, the pedagogical organisation will allow the learner to develop three blocks of competencies described as follows.

 Design and achieve a mechatronic system:

- implement an integrated process of modelling, simulation and multiphysical and multi-technological design,
- select, design and implement the necessary sensors and instrumentation,
- design the mechanical and/or electromechanical architecture,
- select, design and implement the digital infrastructure present in and around the system,
- implement the life cycle of the system or product.

 Manage a research project:

- organize their activity and that of their team,
- report to the head of the research project,
- communicate orally and in writing, in a clear and unambiguous manner and in a style suitable for both specialist and non-specialist audiences,
- consider issues of responsibility for their projects (ethics, ecology, legal and economic consequences).

 Master the skills required for research activities:

- manage and disseminate scientific knowledge,
- apply the principles of professional ethics,
- understand research organisation and funding,
- understand intellectual property issues,
- work in an international environment,
- manage uncertainty and challenges.

◆ Transversal skills

The proposed training also contributes to the acquisition by learners of the following skills:

- autonomy,
- creativity,
- teamwork: cooperation and collaboration,
- communication via ICT (information and communications technology).

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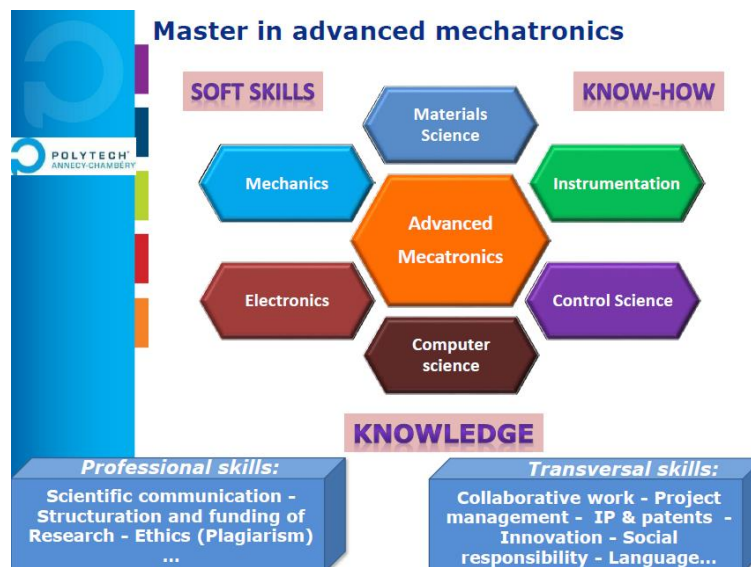


Figure 1: knowledge and skills acquired/developed in the Master's programme in Advanced Mechatronics

I.1.5. Contents of the master's programme

Organised over 4 semesters, the training is based on lectures/tutorials/practicals teachings but also very strongly on autonomous learning from digital platforms and on a project-based pedagogical approach. The Master is taught in English in order to welcome non-French speaking students. Spending one or two semesters within a partner institution is possible in the framework of Erasmus+ agreements.

As mentioned above, semester 9, initially concerned by the XP2P project at USMB, includes 3 Teaching Units (TUs) entitled:

- embedded systems and supervision,
- rights, ethics and scientific dissemination,
- preparation for doctoral studies.

More specifically, the contents of teaching in the teaching units are detailed in the following subsections.

- ▶ introduction to supervision methods, models and tools for embedded systems:
 - embedded computer system (microprocessors, FPGA, PSOC ...), wireless communication technologies (WIFI, Zigbee, Bluetooth ...), integrated sensors (analog or digital),
 - introduction to methods, models and tools for process and application supervision and more generally for systems (information systems, robots, etc. ...), demonstration of a supervision system (e.g. network supervision).
- ▶ Intellectual property, contracts, law:
 - definitions, rights and obligations, French, European and international bodies related to intellectual property,
 - software licences, collaborative work related to software protection,

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- principles of labour law (in the context of research, research and development in Europe), contract and contractual liability, work on examples of research contracts (French, European, private), comparison between some countries.
- ☞ Ethics and scientific diffusion:
 - introduction to ethics, issues studied through the analysis of exemplary cases consequences of new technologies on the privacy of citizens: risks of the Internet of Things, use of personal data,
 - journals and conferences / best practices for writing a scientific publication / how to submit a paper / private/public access / open access - Patents = What is a patent / patent structure / registration body / application process,
 - definition of plagiarism, corresponding risks, legal consequences, plagiarism detection tools, protection against plagiarism.
- ☞ Research funding and PhD communication:
 - funding of research (research projects, doctoral scholarships) and innovation (technology transfer, creation of start-ups),
 - doctoral studies,
 - TOEFL or TOEIC preparation (for students planning to apply for a doctoral position in an English-speaking country),
 - conversation analysis, negotiation, argumentative techniques, written communication.

Beyond that, students are invited to take part in three projects:

- ☞ a group project to participate in the research project of a permanent academic staff member or in a project proposed by an M2 student,
- ☞ an individual project to write a scientific article based on the research project developed in the previous semester or the state of the art on a given mechatronic system,
- ☞ a group project in view of participation in the international challenge Robocup.

I.1.6. Teaching methods and tools

◆ Blended-learning

The advanced mechatronics master's program includes an end-of-studies internship in its last semester.

During the three previous semesters, the student benefited from project-based learning through research topics and prepared the participation to an international challenge.

The first 3 semesters are also based on blended learning allowing the personalization of the students' curriculum according to their background, research project and professional project:

- lectures/tutorials/practicals,
- self-study with online learning platforms,
- individual and collaborative project-based learning in research laboratories,
- supervision of each project by a staff member (associate professor or full professor).

On-line training (or e-learning) is characterised by spatial and temporal relocation. Learners are not obliged to be present in the same places and at the same time as the teachers. This conception of training is reinforced by the advent of networks and Internet-based technologies.

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Blended learning mode refers to the joint use of e-learning or e-learning or Open and Distance Learning (ODL) and the traditional face-to-face learning mode. The learner will thus alternate between online distance sessions and face-to-face sessions with teachers.

As mentioned previously, during semester 9, face-to-face learning is estimated at 74 hours (when there is no lockdown due to an outbreak!) and distance learning at 50 hours. The involvement in two collective projects and one individual project amounts approximately at 500 hours. The whole set of learning activities corresponds to 30 ECTS for the semester.

◆ E-Learning

From a general point of view, the methods used during this training are deliberately varied in order to motivate the participants and allow all learners with different learning styles to take ownership of the training content. The online modules therefore ideally also present varied content (videos, text documents, self-corrected tests, work on forums, virtual classes, Wikis, glossaries, research exercises, etc.).

The pedagogy used is based on constructivism and socio-constructivism, project-based pedagogy and peer learning in a competency-based approach. This training must therefore be flexible to respect the different types of learning and each student must have free access to the content of the 3 TUs at any time during the semester.

The self-study contents of the 3 TUs, totalling 50 hours, are open at the beginning of the semester. However, global and per-CU provisional timetables can be distributed to learners at the beginning of the course, showing the precise opening dates of the different courses on the one hand and according to the progress of each student in carrying out the different pedagogical activities and reaching each objective on the other hand. Even if there is a time requirement, students can work, within a certain framework, at their own pace according to their needs and constraints, but there is a requirement for quality and skills acquisition. Moreover, the activity completion process in the LMS platform allows each teacher to guide students by imposing a rhythm and quality and learning level requirements to access the different educational resources and activities and validate the acquisition of the expected skills.

The calendar is proposed at the beginning of the semester with precise dates for the return of homeworks, the end of the work of each course unit, synchronous appointments at a distance or in presence.

Learners certainly need flexibility, but also solid guidance to achieve the training objectives: the use of the calendar is an essential framing tool for face-to-face and distance tutoring.

Self-learning and the construction of knowledge through action, exchanges and role-playing contribute to the development of the students' knowledge and skills according to their needs and pace. The entire training is carried out with a constructivist approach to learning in order to place the students at the heart of their training. Interactivity, peer learning and learning between learners and teachers contribute to the development of autonomy and communication skills that are indispensable in the professional environment.

The volumes of time and content of distance learning spread over the three TUs of the semester are detailed in the next subsection.

- ✎ Embedded systems and supervision:
 - 12 h for embedded systems introduction to supervision methods, models and tools.
- ✎ Rights, ethics and scientific diffusion:
 - 12 h for Intellectual property, contracts, law
 - 11 h for ethics and scientific diffusion.

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- ☞ Preparation for doctoral studies:
 - 3 hours for research funding and PhD communication.

◆ Project-based Learning

Project-based learning takes place through participation in three tutored projects. The hours spent by students on the projects is as follows :

- ☞ 250 h for the collective research S9 project,
- ☞ 125 h for the individual S9 project,
- ☞ 125 h for the collective S9 project in the framework of the international challenge Robocup.

◆ Personalised support and mentoring of students

Reactive and proactive tutoring is set up all along the semester. The learners benefit from the pedagogical follow-up of the teachers who answer their questions throughout the training course. In addition, reactive technical tutoring is implemented in order to resolve any difficulties related to the LMS platform and the digital tools used.

From a general point of view, distance coaching allows the learners' disciplinary and technical questions to be answered. It is a strong component of psychological support and helps to motivate the learners. It constitutes an organisational and communication aid, beyond disciplinary support. It also supports the link between students, motivating and encouraging each one towards success. It is indeed important to reduce the isolation during distance self-learning sequences (not only geographical, but also cognitive, social and psychological), which induces many changes for the learners compared to the follow-up of a traditional training¹². It can take the following forms, among others:

- asynchronous exchanges by e-mail or forums,
- synchronous exchanges in virtual classes or chats,
- comments posted on the student e-portfolio,
- feedback of assignments posted on the platform.

Support in presence during the lectures, tutorials, practicals and programmed individual meetings make it possible to:

- reinforce the links between students and with the teaching team,
- answer pedagogical, disciplinary and technical questions,
- acquire a methodology for distance and face-to-face learning and for self-organisation,
- readjust the objectives of the learners according to their progress,
- promote remote communication.

Distance and face-to-face support is built on a close relationship and presents a continuum.

◆ Lectures/conferences, exercises and projects in face to face session

The learning moments in the presence of the students, with a total of 74 hours per hour, take place on the Annecy site of Polytech.

¹² Bernard, M. (1999). Penser la mise à distance en formation. L'Harmattan.

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Face-to-face learning allows learners to work with experienced teachers who give them lectures and accompany them during lectures, tutorials and labs (Table 1). They are also in contact with other students from other courses, as well as students from the first year of the Master's program.

They have access to the classrooms, labs, library and various common and pedagogical areas on campus. This allows the students to work in groups on the two collective projects but also to carry on their individual project. During formal and informal meetings, learners can exchange, take advice, document, test, research in groups or individually according to the objectives of the training and which they have set themselves.

The pedagogical meetings in the presence of the learners allow to:

- benefit from the infrastructures and equipment of the school and partner laboratories,
- carry out educational activities with teachers and other students,
- break the isolation,
- facilitate communication and exchanges (particularly online),
- propose a solid methodological support in connection with distance tutoring,
- collect student satisfaction.

Table 1: activities carried out in face-to-face mode

Teaching unit	Course Unit	Lectures	Tutorials	Labs
Embedded systems and supervision	Embedded systems, introduction to supervision methods, models and tools	3h	9h	12h
Rights, ethics and scientific diffusion	Intellectual property, contracts, law	4.5h	6h	//
	Ethics and scientific diffusion	9h	7.5h	//
Preparation for doctoral studies	Research funding and PhD communication	6h	18h	//

◆ Competencies assessment

◇ Assessment methods

The assessment methods are multidimensional and several types of evaluation are proposed to the learners to assess their skills and knowledge (Table 2):

- ☞ formative self-assessment through the creation of an e-portfolio,
- ☞ self-corrected formative evaluations (MCQ, quiz) allowing the learners to see their progress and to readjust their objectives if necessary,
- ☞ formative evaluations validated and corrected by a teacher (various exercises, sheets, homeworks, tests, oral presentations, documentary research, Wikis, forums, projects...),

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- ☞ diagnostic and formative evaluation by peers and teachers: in the form of oral exchanges, comments, grades validated by a teacher, but this can only be formative because it is not possible to ask one student to sanction another¹³,
- ☞ summative evaluation through report writing, oral presentations, homeworks, MCQ tests, and supervised assignments.

Table 2: summary of the evaluation tools and methods implemented according to the pedagogical objectives

Objectives	Methods	Tools
Carry out individual and collective projects Work in a group, collaborate and get organised Evaluate the work of one's peers Integrate active reflection and reflective learning Communicate orally and in writing	Critical and constructive exchanges between students and teachers Teacher feedback on questions, exercises and assignments Remote tutoring Peer review Formative evaluation Group work Writing of a dossier, a Mahara collection and oral presentation of projects	LMS platform with: Forums Wiki-based collaborative workspaces Mail, chat Training schedule with deadlines Virtual classroom Activities in presence
Develop technical and disciplinary skills	Classroom lectures and via remote slideshows or videos Self-corrected practical exercises Remote tutoring Self-corrected tests Classroom lectures, tutorials and labs	Working platform (Learning Management System): courses in consultation, documentary resources Activities in classrooms: structure and training material

The peer evaluation is very enriching for learners. Not only does it reduce the isolation induced by distance learning, but also allow learners to take a step back from their own practice, which encourages reflective analysis. The relevance of the feedback given to peers can also be one of the criteria for evaluating the training.

During project work, intermediate feedback from the teachers enable the groups to reorient and/or enrich their work with a view to the final report. This formative evaluation seems particularly interesting in terms of reflective learning.

Given the modalities of some of the planned feedbacks (e.g. comments on the student's e-portfolio), the formative assessment of the group work, by peers and teacher, will necessarily be semi-public (dissemination within the training) but the potentially negative effect (risk of narcissistic injury) will be minimised by the dilution of responsibility due to the group evaluation and by the fact that teachers will ensure that a climate of trust and goodwill is established from the outset. Other evaluations are private.

¹³ Poumay, M. (2003). L' évaluation formative - Définition, justifications théoriques et illustrations. Document réalisé à l'occasion de la coformation LabSET-ULg, <https://orbi.uliege.be/bitstream/2268/30143/1/EvalForm%20pour%20LabSET.pdf>

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In order to benefit from peer feedback and intermediate feedback from teachers, it is essential that learners respect the deadlines for submission of assignments, as indicated in the training timetable.

Self-assessment is here considered as a pedagogical tool in its own right: the learners measure their degree of achievement of the various objectives. This work, by completing the training evaluation questionnaire, will enable the pedagogical team to evaluate the quality and effectiveness of the proposed system.

Badges can be created in the Moodle platform and assigned to students as they acquire their skills.

These badges are exportable in an OpenBadge Bag and highlighted in the students' Mahara e-portfolio. This type of tool can be duplicated for other USMB training courses, particularly for badges awarded to attest transversal skills and informal learning¹⁴. It can be a motivational tool for students who build their career paths and gradually acquire rewards and recognition by the institution and by their peers for their skills¹⁵.

It is also essential to collect student satisfaction at the end of the course. Indeed, the change brought about by this system must also be analysed from the point of view of satisfaction, which is an integral part of the quality of training and one of its indicators.

An online form made available on the platform and a debriefing at the end of the semester are interesting tools to be set up to collect user satisfaction and allow everyone to suggest possible improvements.

◇ Assessment Criteria

For each assessment, learners are informed of the specific criteria for evaluation. In order to respect the alignment principle¹⁶, these criteria must be clearly linked to the competencies and objectives targeted and to the teaching methods.

The types of assessment depend on the courses and, may be as follows in the next paragraphs.

For the projects, the aim here is to test the acquisition of scientific, technical and transversal competences by placing the students into a professional-type situation. Different criteria should allow the students to be evaluated in groups but also individually thanks to an individual report on the roles of each member of the group. Each member of the group can be responsible for the elaboration of a part of the project proposed by the teacher and evaluated individually on their production with detailed and personalised feedback on the successful or unsuccessful elements. Group work can benefit from both diagnostic and formative evaluations by peers and teachers.

The complexity of the requested task implies subjective assessment. Transactional exchanges with peers and teachers will be all the richer as a result.

The adaptive component present through the freedom left possibly to the learner in the choice of partners makes it possible to empower learners and increase their motivation. It also develops their metacognitive skills.

¹⁴Ravet, S. (2017). Réflexions sur la genèse des Open Badges. De la valorisation des apprentissages informels à celle des reconnaissances informelles - point de vue d'un praticien. *Distances et médiations des savoirs. Distance and Mediation of Knowledge*, 2017(20). <https://doi.org/10.4000/dms.2043>

¹⁵De Lièvre B., Temperman G., & Palm C. (2017). Open Badges: Analyse des effets de leur mise à disposition selon deux modalités de tutorat (proactive ou réactive). *Distances et médiations des savoirs. Distance and Mediation of Knowledge*, 2017(20). <https://doi.org/10.4000/dms.2024>.

¹⁶Anderson, L. W. and Krathwohl, D. R., et al (Eds.) (2001) A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, page 10. Allyn & Bacon. Boston, MA (Pearson Education Group)

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For tutorials and practicals, self-corrected exercises can be proposed. The self-corrected dimension brings freedom and flexibility. It allows learners to develop their autonomy by self-evaluating their progress according to their own objectives.

◆ Technical tools

A Mahara/Moodle ecosystem is created to allow for the diversification of the pedagogy implemented in the Master's program by linking a teacher-centred LMS platform to a student-centred e-portfolio platform.

◇ LMS

The main tool of distance learning is a Learning Management System (LMS) platform for managing the actors (learners, teachers and administrators) and the pedagogical activities programmed as part of the training.

It makes it possible to propose various contents and services listed in the following paragraphs.

☞ online pedagogical content organised in modules and offering:

- pedagogical content,
- educational activities,
- evaluations,

☞ pedagogical, administrative and communication services:

- tools for remote tutoring (forum, chat, mail...),
- collaborative learning tools (wiki...),
- forums and chats,
- an electronic messaging system,
- user tracking tools,
- a calendar and organisation of educational activities.

Learners use the Moodle LMS platform to follow the online courses. This free Opensource solution, based on constructivism and socio-constructivism, is adapted to the proposed training because it allows to provide learners and teachers with many resources and activities and also has the advantage of offering synchronous and asynchronous communication tools.

Teachers must assemble the above-mentioned elements according to their needs, the approaches adopted, and their knowledge and skills, in order to implement pedagogical activities comprising different grains.

Scripting on the LMS notably uses the completion of activities, allowing the automatic validation of the progression from one activity or resource to another for each student according to predefined criteria.

The Master's skills framework is implemented in Moodle so that it can then be broken down into a training plan and thus allow each teacher-designer to assign skills to the activities and thus to link and implement the skills-based approach and the teaching activities themselves.

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In addition, specific activities to implement peer learning can be used, such as glossary, wiki, forum, chat, etc.

The Learning Tools Interoperability (LTI) system allows applications such as a platform like Mahara, for example, to communicate and exchange with the LMS. This makes it easier to interconnect with external services by avoiding configuration sessions each time. A "bridge" is therefore created between the Moodle and Mahara tools in order to create a Mahoodle ecosystem allowing to:

- access the Mahara tool from Moodle, notably thanks to the external tool activity,
- post Mahara pages or collections in Moodle through the Moodle Assignment activity,
- export content from Moodle for publication in Mahara.

◇ E-portfolio

The Mahara platform is the one chosen to develop the e-portfolio of the Master students within the XP2P project (see Intellectual Outputs 3 and 5 of the XP2P project for additional information).

However, USMB uses the Karuta platform to create e-portfolios of competences. This platform seemed very interesting for the XP2P project but in view of the state of progress of its implementation at USMB when the project started, the situation due to the Covid-19 pandemic, and the time allowed to deploy the project, we decided that Karuta will certainly be used in a second phase and it seemed preferable to use the Mahara platform, already used previously at USMB and relatively easy to access. This platform is flexible and is easier and quicker to implement, in view of its use at the beginning of the academic year 2020, to set up the creation and feeding of learning and skills e-portfolios for AM Master students.

Initially, this tool was used for semester 9. Thereafter, its use was extended to the other semesters.

The creation and feeding of an e-portfolio must be framed and accompanied. The students must benefit upstream from training on the tool and work sessions on skills and reflexive learning.

With this in mind, a fictitious student account has been created and populated in order to present to students and teachers some of Mahara's functionalities, via an example:

- the creation and sharing of pages and collections,
- feeding a blog type logbook,
- creating a CV,
- badge sharing,
- the use of competency frameworks.

The [Smartevidence plugin](#) has been installed in order to create and implement skills repositories in the e-portfolio tool. Students and teachers can thus assign themselves or assign levels of achievement of competences. The Master's competency repository has also been implemented on Mahara. The competency grid appears each time it is associated with a collection on the first page of the collection.

◆ Communication tools

Learners and teachers can communicate remotely via synchronous and asynchronous tools available on the two platforms. Tools possibilities are enumerated in the following subsections

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- Moodle Forum allows learners to ask questions to their teacher and the answers benefit for the whole promotion. Other learners can also answer them and collaborative work can thus be set up.
- Moodle Chat allows for coaching and synchronous collaborative work.
- Moodle and Mahara personal mailbox allows communication between learners and between learners and teachers on each platform.
- Moodle Virtual class BBB (BigBlueButton) allows, if necessary, to organise synchronous meetings throughout the training course (motivation of learners, answers to questions, dealing with a particular problem, deepening notions of a course etc...).
- Mahara comments system is the means that students can use to solicit their teachers or peers by sending them pages or collections. Everyone can then, if the option has been chosen, leave a public or private comment.

I.2. Practical implementation and feedback in Semester 9 of Master AM (Instructor view)

I.2.1. Competency-based training

◆ Reminder of the framework for this analysis

The teaching method deployed at Master level is a generalised Competence Based Approach and tends to install a dynamic ecosystem of knowledge transmission.

Context is given as follows:

- ☞ master AM,
- ☞ internationalisation,
- ☞ development of Competency-based Approach (Approche par Compétences = APC) and hybridisation of courses,
- ☞ definition of a competency framework,
- ☞ learning and assessment situations provided by the projects,
- ☞ S9 teaching team (full-time teachers, part-time teachers).

A competency (Figure 2) is considered as an ability to act, based on the effective mobilisation and combination of internal and external resources within a family of situations¹⁷.

¹⁷ Tardif, J. (2006), L'évaluation des compétences. Documenter le parcours de développement, Montréal, Chenelière Education, p. 26-35.

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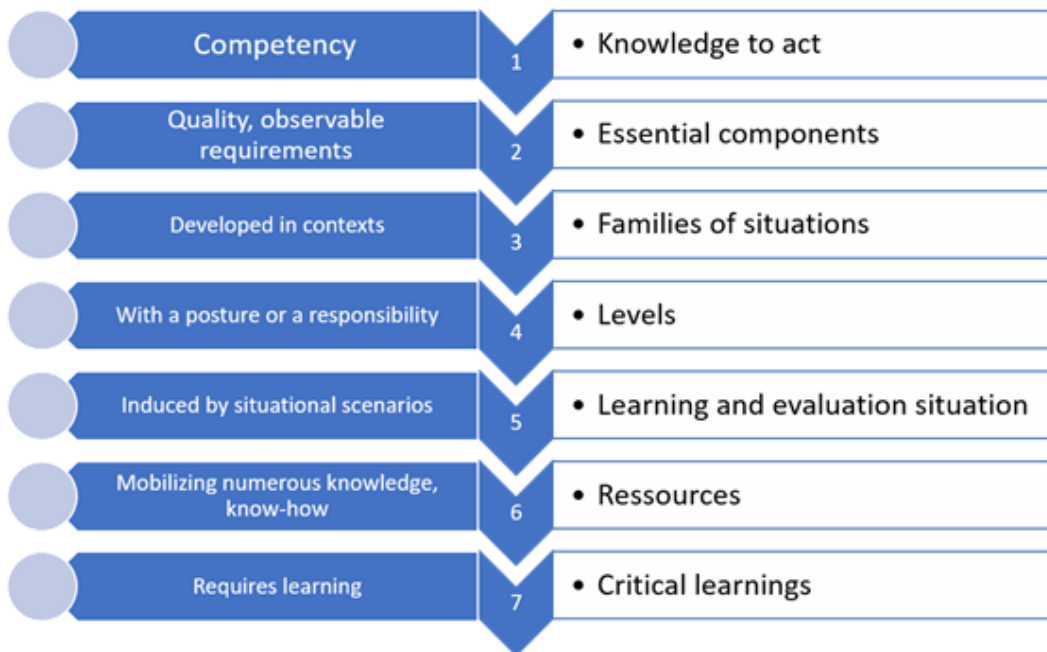


Figure 2: a view of how a competency can be defined

Reminder of the overall goal in semester 9 in the master's programme in Advanced Mechatronics:

- the aim is to acquire competencies assessed on the basis of the results of activities defined within the framework of the Master's degree, in particular "project" activities.
- two platforms are used to follow the training: the learning Management System (LMS) Moodle and the e-portfolio trace collection and skills analysis system Mahara.

Example: English is the language used in all activities and also in a specific module. It is taken into account in the communication skills.

◆ Educational ecosystem

The competency-based approach is a change of pedagogical paradigm and requires a global transformation of the pedagogy and the environment involving for example:

- reflective analysis,
- Learning Management System,
- E-portfolio management,
- learning analytics,
- ubiquity of "teachers" (co-modal learning, peer learning and validation),
- remote and asynchronous resources (Flash learn, Mooc, remote lab).

1.2.2. Preparing and achieving activities

◆ In Moodle, the competencies are modelled

The competency framework defined for the master AM is used to complete the Moodle competency module (Figure 3).

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Active_2020_Master AM 2 S9 competencies grid

Valid Competencies grid of the Master Advanced Mechatronics 2020

2020_11_28 Référentiel de compétence actif

- ▶ C11 - Implement integrated process of multi physics multi-technology modelling, simulation, design
- ▶ C12 Choose, design and implement the required sensors and instrumentation
- ▶ C13 Design the mechanical and/or electromechanical architecture
- ▶ C14 Choose, design and implement the digital infrastructure present in and around the system
- ▶ C15 Implement the lifecycle of the system or product
- ▶ C21 Organize his/her activity and the activity of his/her team
- ▶ C22 Report to the research program manager
- ▶ C23 Consider questions of eco-responsibility of his/her projects and their legal and economic csq
- ▶ C31 Manage scientific knowledge
- ▶ C32 Spread scientific knowledge
- ▶ C33 Apply the principle of professional ethics
- ▶ C34 Know how Research is organized and funded
- ▶ C35 Understand the issues of intellectual property
- ▶ C36 Work in an international environment
- ▶ C37 Manage uncertainty and challenges

Figure 3: competency framework implemented in Moodle (condensed view)

◆ Learnings and Evaluation situations

◇ Outline of the project process

Project-based learning is widely used in training, to place students in a learning situation. A range of activities has been created. Each activity is associated with the skills that are developed (Figure 4).

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+ Overview and transverse activities

In the cross-cutting activities, you will find a question and answer forum related to the activities of the individual project. This type of activity is intended to promote exchanges between peers. It is present in each activity. You are expected to invest time in these activities, which develop multiple skills but also, and most importantly, the ability to take a step back.

+ T2 - P2P Forum
👤
📧

TaskID: PROJ901_P2P Forum

Activity to be completed: Forum A&Q

S/ Competencies C11, C12, C13, C14, C36

Ask a question, answer question type Forum / Individual work

For this forum, you are asked to make a request for a technical or scientific problem you have. This will require that you already have a good understanding of your project. Once you are immersed in your project, you may encounter problems that you don't think you can solve. This forum allows you to expose your problems and solicit your colleagues for assistance.

On the reverse, you should be able to bring answers to a problem/question set by your colleagues. Five contributions are expected to complete the task. Contributions are evaluated and help to show your skills.

You should not ask questions for opinions. You must formulate a precise, specific question that relates to a misunderstanding, a technical difficulty, a particular problem that you are unable to solve.

The answer must be precise and factual. You can call upon existing knowledge, which you will obviously have to cite.*

You are also asked to: comment on the answers (in the form of a supplement) and **participate in the evaluation of the questions and answers**.

In case of doubt, contact the person in charge of the 2nd year of the master

+ L1 - Collective Project Introduction
👤
📧

TaskID: PROJ901_Introduction

Activity to be completed: consultation of the scorm package

Competence: C21

Type: Scorm packet

activity: consult the presentation / Individual work

Figure 4: example of activities

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◇ Ressources and critical learnings

Specific modules are also developed for basic learning (Figure 5).

♻️ S-P2P-FP PROJ902 - Individual S9 project

Individual S9 project to write a scientific article based on the S8 research project or the state of the art on a given mechatronical system

♻️ S-P2P-FP - RECH902 - Ethics and scientific diffusion

Introduction to Ethics, issues studied through the analysis of exemplary cases consequences of new technologies on citizens' private life: risks of the internet of things, use of personal data

Reviews and conferences / best practices for writing a scientific publication / how to submit a communication / private/public access / open access - Patents = What is a patent / patent structure / registering organization / process of application

Plagiarism definition, corresponding risks, legal consequences, plagiarism detection tools, protection against plagiarism

♻️ S-P2P-FP - RECH901 - Intellectual property, contracts, law

Intellectual property: definitions, rights and obligations
French, European and international organisms
Software protection: software licenses, collaborative works
Principles of labor law (in the context of research, research and development in Europe)
Contract and contractual liability
Work on examples of research contracts (French, European, private), comparison between a few countries

Figure 5: examples of specific modules developed for basic learning

◆ Peer-to-Peer (P2P) learning

P2P learning does play an important role in Competency-Based Learning. The usual teaching paradigm being over, one needs to pay personal attention to every student. The teacher alone cannot provide sufficient support and care to each student especially in the case of large groups.

During the two experimental semesters covered by the P2P program development, one focused to integrate P2P activities in the pedagogical process. They were also supported by the corresponding activities in Moodle such as:

- 📖 Forum (Figure 6),
- 📖 workshops,
- 📖 database,
- 📖 wikis.

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Discussion	Groupe	lancée par	Dernier message ↓	Réponses
☆ Source rapport pour le 15/03	Cohorte MM4-M...	Pei 1 mars 2021	Po 3 mars 2021	1
☆ Activité PA1_6 Recherche et analyse de solution	Cohorte MM4-M...	De 1 mars 2021	Dé 1 mars 2021	0
☆ Différence entre collaborateur et gestionnaire	Cohorte MM4-M...	Co 1 mars 2021	Dé 1 mars 2021	1
☆ Panne plateforme GED	Cohorte MM4-M...	Ni 1 mars 2021	Pe 1 mars 2021	1
☆ Reprise TD Alfresco	Cohorte MM4-M...	Ch 1 mars 2021	Ch 1 mars 2021	0
☆ Alfresco	Cohorte MM4-M...	Be 1 mars 2021	La 1 mars 2021	2
☆ Connexion PC à distance	Cohorte MM4-M...	Ric 1 mars 2021	Ri 1 mars 2021	3
☆ ...	Cohorte MM4-M...	Ca 1 mars 2021	Cc 1 mars 2021	~

Figure 6: example of a forum in product lifecycle activities

Besides these formal activities, it was well identified that hybrid learning based on the multiplication of situations where the students have to share reciprocally their knowledge provides opportunities to develop peer to peer support. Most often, it was chosen to pair students with complementary technical competences.

I.2.3. Assessment of activities

◆ Activity evaluation grid

Integrate the social, ethical and environmental dimensions	No SEE dimensions <i>0 points</i>	Minor considerations for SEE dimensions <i>1 points</i>	Strict minimum for SEE dimensions <i>2 points</i>	Good <i>3 points</i>	Very good <i>4 points</i>	Outstanding <i>5 points</i>
Identify the specific problem of the project	No problem identified <i>0 points</i>	Identification of small part of the problem <i>4 points</i>	Minimal problem specification is proposed <i>8 points</i>	Good <i>13 points</i>	Very good <i>16 points</i>	Outstanding <i>20 points</i>
Quality of the presentation	No quality <i>0 points</i>	Large progress expected <i>4 points</i>	Minimum quality <i>8 points</i>	Good <i>13 points</i>	Very good <i>16 points</i>	Outstanding <i>20 points</i>

Figure 7: example of activity evaluation grid

Whatever the learning process is, it is necessary to ensure the most objective assessment. The assessors should be teachers or peers who are involved in the assessment process. To ensure equity and fair evaluation, precise assessment guidelines should be put in place. It is necessary to be able to produce reproducible assessments independent of the assessor. There was a lot of preparatory work to design the evaluation grid (Figure 7). Post processing the results shows that improvements are still achievable.

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◆ Link activity to skills

The possibility to follow-up the achievement of activities in Moodle (Figure 8) allows to link this achievement to the development of the skills.

▼ **Achèvement d'activité**

Options d'achèvement déverrouillées

Lors de l'enregistrement, l'état d'achèvement des activités de tous les participants sera supprimé. Si ce n'est pas ce que vous voulez, n'enregistrez pas.

Suivi d'achèvement

Affichage requis Les étudiants doivent afficher cette activité pour la terminer

Note requise Les étudiants doivent recevoir une note pour terminer cette activité Le participant doit remettre quelque chose pour terminer cette activité

Achèvement attendu le Activer

Figure 8: follow-up of the activity achievement in Moodle

Once the activity is completed, the competence related to the activity can be fully or partially validated (Figure 9)

▼ **Compétences**

Compétences de cours

- × MultiPhysics in PROJ901 Sysml C11_PROJ901_Sysml
- × Report to PO in PROJ901 Sysml C22_PROJ901_Sysml
- × Ecoresponsibility in PROJ901 Sysml C23_PROJ901_Sysml
- × Uncertainties and challenges in PROJ901 Sysml C37_PROJ901_Sysml
- × Lifecycle in PROJ901 Sysml C15_PROJ901_Sysml

Rechercher

Lors de l'achèvement de l'activité :

Figure 9: competency and achievements of activities

◆ Overall validation of skills

The participant must validate all the competencies of the reference system by carrying out activities connected to the reference system.

This framework is also used in the context of the job placement (Semester 10).

Thus, at the placement level, the students should ensure that they complete the activities as part of their activities in the company or laboratory.

The criteria grid is based on a transverse-skill referential defined for the master's degree in advanced mechatronics. 4 levels are defined, which should reflect the degree of autonomy and ease of learning. For each competency item, a learning and assessment situation is defined (here the activities during the internship). In some cases, the work situation occurring during the internship may be not fully appropriate and thus does not allow to check that the required level is reached despite the qualities of the learner/student.

It is also expected that the student gains knowledge and skills during the internship by means of connection with experts or through self-learning activities. The student should then also collect evidence during the internship, in order to sustain the evaluation.

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For each essential component of the competences, the following information can be provided:

- examples of work situations,
- tools and methods that have been used,
- actors the student interacts with
- evidence that can be exhibited to assess the level of implication of the student.

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Master skills	Missions carried out attesting to a competence and its level	Trainee Competence during internship	Self Eval	Tutor observations	Ext Eval
Block 1: Defining and Solving research problems					
By identifying problematic, challenge, uncertainties, social, environmental, ethical, economical issue of the project					
By making exhaustive context analysis including state of the art, IP search, bibliographic studies					
By conducting methodological analysis and choosing the adapted method for developing the project study, defining realist objectives for the project (SMART)					
By producing original content, critical review, (vs problematic) perspectives, with respect to ethical standards					

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Master skills	Missions carried out attesting to a competence and its level	Trainee Competence during internship	Self Eval	Tutor observations	Ext Eval
Block 2 (Research) Project management					
By knowing research organisation, research funding and understanding project funding					
By organising the project with suitable and justified project method and adequate time management					
By producing quality deliverables regarding indicators (SMART)					
By having team ad hoc management (Project Owner, Team Member)					
By producing suitable written documents throughout the project					
By communicating and interacting efficiently with people throughout the project					
By managing data in project and applying product life cycle follow-up					

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Master skills	Missions carried out attesting to a competence and its level	Trainee Competence during internship	Self Eval	Tutor observations	Ext Eval
Block 3: Contribute to design and achieve a mechatronic system					
By defining the functional specifications and the global architecture of the system					
By understanding, designing and developing the physical core of the system					
By understanding choosing, designing and implementing the required sensors and corresponding instrumentation					

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◆ Follow-up of activities

This part is related to the learning analytics needs when competency based learning is involved. The teachers lose their usual role and dedicate their time to supervising, monitoring activities.

Competency-Based Learning (CBL) requires also to give more autonomy to the students. Connected phenomena are induced by this acting freedom.

Procrastination is one of the side effects. Students think they have seen more the objective of the work than the path to reach the goal. Students pay more attention to the objective of the work than the path to reach the goal.

Some students use what they consider free time to take up jobs to increase their student income.

Some students deviate from the path, being sometimes lost to such an extent that they miss the point. The corollary difficulty is the appropriation of the project and the good reporting strategy to the project owner.

However, there are some useful tools allowing us to monitor students' activities in Moodle (Figure 10).

E-portfolio also allows one to have a good overview of the personal activities and competency development.

Prénom / Nom	Adresse de courriel	T1 - Tasks list in the ...	T2 - P2p Forum	L1 - Collective Project ...	L2 - Launching collective ...	W1.1 - CP Charter template	W1.2 - CP Pictures inventory	W1.3 - CP Problematic ...	W1.4 - CP Syml application	W1.5 - CP Timeline of the ...	W1.6 - CP Project charter ...	W2 - CP State of the art	W3.1 - CP Mechatronics ...	W3.2 - CP Implementation of ...	W3.3 - CP Mechanical and ...	W3.4 - CP Data ...	C1 - CP Cloturing ...	C2 - CP Report	C3 - CP Presentation	C4 - CP PROJ01 - Mahara ...	R1 - Project Charter template
B...	An...@voie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ei...	Sal...@etu.univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E...	Ker...@etu.univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H...	Ah...@savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Li...	Jea...@univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
M...	Mc...@univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
M...	Ho...@savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pe...	Vet...@univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
St...	Eli...@univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Te...	No...@etu.univ-savoie.fr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 10: example of activities follow-up in Moodle

◆ Reflexive Analysis

The use of e-portfolio is unavoidable when dealing with Competency Based Learning. As mentioned just before, it allows to ensure that the students' skills develop regularly. It allows the students to propose others to assess their proposals. They can take advantage of others' advice as well as expertise that can help them to fulfil their objectives (Figure 11).

Member of Moodle-USMB

general information

No
25 years

Engineering degree in MECHANICAL ENGINEERING (ENERGY SYSTEMS)
from : NATIONAL POLYTECHNIC SCHOOL of ORAN (ALGERIA)

Master degree in ADVANCED MECHATRONICS
from : POLYTECH ANNECY- CHAMBERY , SAVOIE MONT BLANC UNIVERSITY (FRANCE)

[curriculum vitae \(english version\)](#)
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about me

No...e, young mechanical engineer and master in advanced mechatronics, well trained, motivated, ambitious, , creative and very interested in everything related to engineering and conception, social, who likes group work and above all carrier of very good ideas for companies development.

No...bi's portfolios

ADVANCED MECHATRONICS FIRST YEAR PROJECTS (4 pages)
this collection contains a part of projects and tasks we had to finish in the first year of adv...

I A S CP Data infrastructure (in and around)

self assessment collective project
in this page you will find my self assessment in collective project , some aspects are evaluated ...

self assessment individual project
in this page you find the self assessment of individual project , some of aspect are evaluated wl...

self assessment individual project v 2
in this page you find the self assessment of individual project , some of aspect are evaluated wl...

5 results

No...bi's friends

19 friends

No...bi's wall

Maximum 1300 characters per post.

Paragraph **B** *I*

Words: 0

Make your post private No

Post

Figure 11: example of public welcome page of a student's e-portfolio in Mahara.

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I.2.4. P2P Learning canvas - Assessment and prospects in the framework of the Master AM – USMB

This last section is dedicated to the lessons that can be learned from this first set of experiences on peer learning from a holistic perspective

◆ Dimensions of (peer) learning

There are several dimensions in peer to peer learning that involve:

- ☞ how to do it,
- ☞ knowledge,
- ☞ method and organisation,
- ☞ autonomy,
- ☞ reflexive assessment, definition of learning objectives.

◆ Typology of peer learning

Horizontal and vertical peer learning have been identified during those two years.

◇ Horizontal

- ☞ students of the same level who help each other (exchange of knowledge),
- ☞ solve difficulties together.

◇ Vertical

- ☞ supervision/Tutoring occurs in cascade in the order teachers → PhD Students → master 2 student → master 1 student → bachelor's student,
- ☞ acting as example,
- ☞ carrying demonstration, giving explanations,
- ☞ providing direct benefit of the knowledge or experience,
- ☞ in return, new perspectives on the project, added-value on the project.

◆ P2P Interactions

Interactions are of different natures:

- ☞ from individual to individual (companionship, e.g. PhD tutoring),
- ☞ by clusters (“grappes” in French) (StudentS → StudentS)

◆ P2P Activities (*modus operandi*)

◇ Synchronous

- ☞ mutual aid (forum),
- ☞ skills trade (through multidisciplinary project).
- ☞ joint-venture (merging skills to provide more = skill reinforcement)

◇ Asynchronous

- ☞ evaluation (Moodle Workshop),
- ☞ video production.

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◇ **Formal, unformal**

◆ **Econometrics of P2P (investment vs. profit)**

- ☞ The process is Win-Win:
when I teach, I learn,
I learn from the others.
- ☞ Overall, the group's performance improves itself through the process.
- ☞ The reputation of the group increases (benefit for employment and internship offers).
- ☞ Efficiency (less time spent to learn) even though the process requires personal investment for others because it allows for self-learning at the same time (notably through reformulation and the effort of argumentation).
- ☞ P2P is itself a learning and assessment situation → some specific validations can come from the P2P activities (communication, group management, initiative, knowledge itself).
- ☞ If P2P activities are fairly adopted by the students, equity is maintained (results and ranking have to be fair at the end).

◆ **Validation of learning**

◇ **Indirect**

Competency validation, increase of the student level during the process and assessment of the final level

◇ **Direct**

- ☞ The validation by supervisors is a complicated process and requires delegation to students.
- ☞ It is difficult to follow every student's interactions.
- ☞ It is difficult to evaluate.

◆ **Formalisation**

- ☞ No real legal support / "evasive" study regulations.
- ☞ Voluntary → Included in the teaching process (not obvious).
- ☞ Intrinsic difficulty in tracking/assessing student P2P activity which can occur freely, anywhere, anytime.
- ☞ Equity issue in conducting P2P activities.

◆ **Tools**

Tools are needed to support P2P activities.

◇ **LMS Moodle:**

- ☞ forum (mutual aid),
- ☞ workshop (specific activity in Moodle to carry out cross-evaluation),
- ☞ P2P evaluation of oral presentations.

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◇ Video, documentations:

- ✎ Personal equipment (or use of personal equipment of teachers/students)
- ✎ Equipments provided by the university,
- ✎ Software.

◇ Comodal teaching/learning, interactive boards

- ✎ Speechi, pc,
- ✎ Teams, Zoom,...

◇ Offices in research laboratory:

- ✎ “real” offices made available to master’s students, offering common space in order to interact.

◆ Risk, fears

- ✎ lack of equity,
- ✎ (too much) delegation of teaching/supporting roles to students (thus prerogatives lost by teachers).

◆ Balance sheet

- ✎ Introduction of P2P is necessary in a competency-based approach (overload of the supervising staff otherwise).
- ✎ Difficulties to identify the student contribution to the system, deep change in their working process/attitude/responsibilities.
- ✎ Introduction of P2P is beneficial (but indicators have to be refined and better evaluated).
- ✎ When discovering the P2P process, one often uses only a few possibilities (face to face focused on pure knowledge P2P exchange is one of the most supposed P2P interactions).
- ✎ There is a wide possibility of P2P activities, only a few could be covered up to now.
- ✎ A rather small part of P2P possibilities were covered in this first phase during the XP2P project but we got a great increase of experience. This is also due to the fact that a lot of prerequisites/preliminaries are necessary (Competency-based learning is a big deal with a lot of unexpected issues and carries a lot of simultaneous changes for the pedagogical team).

◆ Perspectives

- ✎ For P2P, the implementation and use of learning analytics should allow a better assessment of the students’ implication.
- ✎ The exploration of other forms of P2P activities should allow to build communities of practice within student groups.
- ✎ All dimensions of learning (knowledge, soft-skills, know-how, autonomy etc.) can be addressed in this approach.

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Two short examples of practical applications of peer learning/assessment activities in courses dedicated respectively to PhD studies (for master 2 students) and Electromagnetism (for master 1 students) are given in the following sections.

I.3. Peer learning/assessment activity implemented for master 2 students

As the master's programme in Advanced Mechatronics at USMB is research-oriented, information, tips and training about PhD studies and research funding are provided to the students during in-class sessions. To conclude this training, a Moodle workshop is planned, the objective of which is to help them prepare themselves for finding a PhD student position or a position in the research domain. The overall description of this workshop and instructions given to the students for the workshop in 2021/2022 are given below.

You have to prepare a resume and a cover letter as if you were going to apply for a position in research (for a PhD or a graduate position).

You will upload these documents and afterwards assess the documents of three fellow students.

This allows you to prepare yourself and to help the others prepare their future applications as well.

Here are the instructions:

- Using the different weblinks you were given during the RECH903 sessions (as well as [this one](#) where you will find titles and summaries of French PhD theses), look for a position in a research laboratory you would like to apply for (fictitiously); you can choose either a current open position or a position which was already proposed in the past; the position can be a PhD position or a graduate position.
- Document 1: prepare a first document describing the position (in ~2000/3000 characters). This document will include the title of the position, the corresponding research laboratory. If it is a PhD position, it will include the university, the names of the supervisor(s) and information about the funding (not only the wages but also the research funding).
- Document 2: prepare a resume (C.V.) corresponding to this application.
- Document 3: write a cover letter as if you were going to apply for the position.
- **Merge documents 1, 2 and 3 in a unique document (doc, docx or pdf), name the new file Yourname_RECH903 and upload it in the corresponding assignment activity in Moodle by 18th January.**
- **Between 19th January to 31th January, carry out the workshop activity in Moodle where you will be asked to give feedback to 3 fellow students about their CVs and cover letters.** You will have to:
 - assess the quality of their writing and layout, the statements about competencies and skills in the resume, the relevance of the cover letter
 - identify 1 positive feature and 1 feature which would need improvement according to you, in both documents; explain why the former is positive, why the second needs improvement and how it could be improved. This will be done in the comment section.

The assessment form consists in 14 criteria related to the CV and to the cover letter (see

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Table 3). The detailed assessment form is given in Appendix 1.

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Table 3: Criteria to take into account for the assessment (Moodle Workshop)

Resume	Cover Letter
Spelling problems (grammar, typing error...)	Spelling problems
Layout	Layout
Competencies and skills	Motivation
Education	Logical ordering of the arguments
Professional experience	
Hobbies	

It is worth mentioning that these assessment criteria must also be understood as advice for the students for their future applications.

Note also that this assignment is graded. The grade is taken into account into the grade of the whole module which also includes training in English for scientific communication.

To conclude, this class with its Moodle workshop allows students to reflect about their career plan and to grasp the criteria to prepare their future application. First, they know how they can proceed to find job offers in research, but above all, they know how to prepare their cover letter and CV for their future applications. They can confront their own production to those of their peers and thus achieve a kind of benchmark to improve their future applications.

I.4. Peer learning/peer assessment activity with master 1 students

Here the peer learning/peer assessment activity was implemented in a class dedicated to master 1 students; that deals with the fundamentals of antennae. It is essentially self-paced during a semester, with only 1.5 hours of in-class tutoring to answer students' questions. Lecture resources are available via the LMS (Moodle) and several self-corrected exercises or quizzes are proposed.

Instead of presenting a catalogue of common electromagnetic communication protocols (Bluetooth, GSM, Wifi), it was decided to ask the students to find the relevant information themselves. Then through to a Moodle workshop, they share the result of their work and assess their peers' work. The assessment is organised in such a way as to allow the assessment of works related to the 3 communication technologies if possible. The section below describes this Moodle workshop (screenshots of the Moodle workshop are given in Appendix 2).

Bluetooth, GSM, Wi-Fi - Graded assignment

Each of you is asked to look for information about **one of the wireless systems**: Bluetooth, GSM, Wi-Fi.

You will prepare a document (pdf, odt, doc or docx) containing at least the following information:

- ✓ Brief summary of the technology history
- ✓ Bandwidth
- ✓ Examples of emitting/receiving antennae (size, power, conditions of use)
- ✓ Usual values of radiated power
- ✓ Standards & Regulations
- ✓ List of references (list given according to IEEE standard)

The work must be done individually.

You will pay attention to the writing (structure of the sentences, clarity) and to the spelling.

Then you will upload your document in the workshop below and you will be asked to assess the documents of 3 fellow students.

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Before starting the collection of information, discuss together if necessary and [answer the survey](#) below to express which of you will study which technology so that there will be 4 students studying 2 technologies and 5 students studying the third one.

Deadlines:

- ☞ 27/03/2022 to [answer the Moodle survey](#) (choose the technology you are going to study)
- ☞ 15/04/2022 to [submit your work \(pdf, odt, doc or docx document\) in the Moodle workshop](#)
- ☞ 03/05/2022 to [assess the work of your peers according to the criteria specified in the Moodle workshop.](#)

The Figure 12 represents the assessment grid the students must use to assess their peers' work.

Criteria	Levels			
1. Brief summary of the technology history	<input type="radio"/> There is no summary of the technology history.	<input type="radio"/> There is a summary but it is too short, or too long or not understandable.	<input type="radio"/> There is a summary of correct length. It is understandable.	
2. Bandwidth	<input type="radio"/> The bandwidth is not specified or it is specified but the value is not correct.		<input type="radio"/> The bandwidth is specified and correct.	
3. Examples of emitting/receiving antennae (size, power, conditions of use)	<input type="radio"/> No examples are given or the given examples are not relevant.	<input type="radio"/> There is only one example.	<input type="radio"/> There are at least an example of a receiving antenna and an example of an emitting antenna. However no details are given about their size, power and conditions of use.	<input type="radio"/> There are at least an example of a receiving antenna and than an example of an emitting antenna. Relevant details are given about their size, power and conditions of use.
4. Usual values of radiated power	<input type="radio"/> The usual values of radiated power are not specified.	<input type="radio"/> Usual values of radiated power are specified but there are wrong.	<input type="radio"/> The correct usual values of radiated power are specified.	
5. Standards & Regulations	<input type="radio"/> There is no information about standards and regulation.	<input type="radio"/> Information about standards and regulation are given but there are errors.	<input type="radio"/> Information about standards and regulation are correctly given.	
6. List of references	<input type="radio"/> There is no list of references.		<input type="radio"/> There is a list of references but not in IEEE standard.	
7. Further information	<input type="radio"/> No additional information is given or additional information is given but is not relevant.		<input type="radio"/> Additional information is given and it is relevant.	
8. Quality of the writing	<input type="radio"/> The document is badly written: the structure of several sentences is not correct, there was no drafting effort.	<input type="radio"/> The writing is not optimal: the structure of a few sentences is not correct but there was a drafting effort.	<input type="radio"/> The writing is correct: there was a drafting effort.	<input type="radio"/> The writing is more than correct: there was a drafting effort and the document is pleasant to read.
9. Spelling and grammar	<input type="radio"/> There are more than 5 spelling or grammar mistakes.	<input type="radio"/> There are 4 or 5 spelling or grammar mistakes.	<input type="radio"/> There are 2 or 3 spelling or grammar mistakes.	<input type="radio"/> There is 0 or 1 spelling or grammar mistake.

Figure 12: assessment form of the Moodle workshop dedicated to antennae for wireless communication

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Then a survey via Moodle was proposed to the students to get their opinion about the assignment after its closure. The survey contained 6 questions and received 7 answers out of 13 students. The results are given below.

Question 1: According to you, thanks to the first part of the assignment (document preparation),

- you have not learnt anything about the considered technology. 0
- you have learnt only a few features about the considered technology. 0
- you have learnt quite a lot about the considered technology. 2
- you have learnt a lot of features about the considered technology. 5

Question 2: According to you, thanks to the second part of the assignment (assessment of your classmates' document),

- you have learnt nothing about the considered technologies. 0
- you have learnt just a few features about the considered technologies. 0
- you have learnt rather a lot features about the considered technologies. 3
- you have learnt many features about the considered technologies. 4

Question 3: Approximately how much time did you spend to do the first part of the assignment (information finding and document writing)?

- less than 1 hour 0
- more than 1 but less than 2 hours 0
- more than 2 but less than 3 hours 1
- more than 3 hours 6

Question 4: How would you qualify your work to prepare your own document?

- I was not committed. 0
- I was moderately committed. 1
- I was rather committed 1
- I was very committed. 5

Question 5: How would you qualify the way you assessed your classmates' documents?

- My assessments were not done seriously. 0
- My assessments were done with moderate seriousness. 0
- My assessments were done rather seriously. 5
- My assessments were done very seriously. 2

Question 6: Do you have any suggestion or comment about this assignment?

- Actually, I have no suggestion, I really liked the assignment, because it helped me to learn about a new technology which I really did not know that much details about it. Hence, thanks to this assignment, I gathered a lot of interesting information.
- Honestly, I like this type of assignments and assessments because it motivates me to work hard in order to meet the requirements and be assessed by my classmates. In addition, it

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makes me learn more about the subject and get new ideas by reading and assessing my classmates' work where I can find more fruitful information and ideas.

As for the previous example, it is worth mentioning that the graded result is taken into account in the final grade of this course. This ensures the participation of all students!

Finally, other workshops and other peer-to-peer activities were set up in the LMS Moodle for master 1 students (forums, glossary, Mahara/Moodle assignments). A list is proposed in Appendix 3.

I.5. Peer learning and project-based learning implementation in a group project

A third example of application of peer learning is available in [this video](#). It deals with the organisation of the first year master student to manage their Robocup collective project during the spring semester of 2021/2022 academic year. Camilo Hernandez explains how the students have been working and the benefit they have found thanks to their organisation.

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II. Practical implementation of peer learning semester/module in the master in Mechanics/Mechatronics at HSKL

At HSKL, peer-learning and the use of an eportfolio were implemented in the course “System level rapid development in mechatronics” during 2 academic years (2020/2021 and 2021/2022). In 2021/2022, the experience was transferred and adapted in the course “Lightweight Design”. The following sections describe the process followed and the observed results.

II.1. Experience implemented in the course “System level rapid development in mechatronics”

II.1.1. Persons involved

◆ Students

1st XP2P Semester (2020/2021)

- Number: 10, of which all male
- Nationalities: 6 international students - 2 worked digitally from India.
- Previous experience with mechatronics: the students have different backgrounds regarding their skills in the topics covered in the lecture.
- Previous experience with P2P-education: none

2nd XP2P Semester (2021/2022)

- Number: 14, of which 1 female and 13 male.
- Nationalities: 4 Erasmus+ Students from USMB (Annecy), 5 international students.
- Previous Experience with mechatronics: Students have different backgrounds regarding their skills in the topics covered in the lecture.
- Previous experience with P2P-education: 1 student participated in the 1st XP2P Semester at USMB.

◆ Teaching Staff

The teaching staff was composed of the following people:

- Prof. Dr. Gerd Bitsch, Professor for Mechatronics and Robotics,
- Christopher Mäurer, B. Eng., Assistant in Robotics and Mechatronics (50%) and Master-Student in Mechatronics,
- Marina Zingraf, M.A., Social Scientist; Training in pedagogy and adult education as part of a social science degree,
- Prof. Dr. Albert Meij, MSc. Aerospace Engineering; PhD on Processing of Glass Mat Reinforced Thermoplastics in Automotive Applications; 25 years of teaching experience as Professor for Lightweight Design, Polymeric Composite Materials and Product Development.

II.1.2. Semester assignment

◆ Tools/Methods (WS 20/21)

Goal: Develop and improve competences in system level engineering/development.

Idea: Students get an already, but just roughly working, system (two-wheel self-balancing robot) as ready to use hardware and they get the corresponding simulation model as well. The system behaviour

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has to be improved by using and adapting the simulation model and results have to be verified by running the real hardware.

For easier comparison of the improvements, the robot (real and in simulation) has finally to fulfil some predefined tasks:

- run as fast as possible
- run fast with 360 degree turns every meter
- adapt for changing the centre of gravity by adding an off-balance additional weight
- drive a precise figure eight

Setup: Students are working in small groups of 3 to 4 Students (every student gets an own robot to work with). Usually, 4-5 groups can form in the lecture session. Some parts of the work are developed in a group but every student has/should have some focus on a specific topic as well (topic is free of choice).

A written collateral guides the students through the complete semester that is divided in 2 main parts:

First half: Acquiring the necessary competences to understand and work with the simulation model, as well as how to transfer algorithms from simulation onto the real-life robot. This includes e. g. multi body simulation, control design, state charts and code export.

This is necessary due to the fact that students have different backgrounds regarding their skills in one, some or all topics covered in this module

Second half: Improving the behaviour and skills of the robot and simulation and real life.

Table 4: project schedule (1st XP2P semester; same plan applies in 2nd XP2P semester but with different dates)

Nº	Topic	Duration [weeks]	milestone date
1	Setting up the S/W environment	2	26.10.2020
2	Multi body simulation		
3	Control design	1	02.11.2020
	buffer	1	M1: 9.11.2020
4	State machines	1	16.11.2020
5	Code export	1	23.11.2020
6	Setting up and testing the two-wheel robot	1	30.11.2020
	buffer	1	M2: 7.12.2020
7	The tasks to master	5	M3: 18.01.2021
		13	

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Support: The assistant gives first level support for the students regarding technical issues. To do this, students can use the assistant's regular online consultation appointments (every 2 weeks) or contact him by email. The professor still keeps track of the students' performance because the assistant reports to him, he also passes on tips and hints from the professor to the students. It is not transparent to the students that the professor is involved in this process.

Feedback: Feedback is given as comments in the e-portfolio in Mahara at predefined milestone dates (three milestones spread over the semester, see Table 4). Concerning potential issues with the Mahara e-portfolio platform itself, students could ask Ms. Zingraf in regularly scheduled online meetings and by email.

Assessment: Based on the e-portfolios in conjunction with the assessment table (see Appendix 4).

◆ **Tools/Methods (WS 21/22)**

Only the changes to the 1st XP2P semester are mentioned below.

Feedback: Students had to present their e-portfolios in a short presentation (~10-minute presentation) one week after each milestone. This makes assessment easier for the teaching staff, as this makes individual student performance visible and allows teachers to better understand how well students are actually familiar with the content in their e-portfolios. In this way, students have e.g. to provide spontaneous transfer services in response to direct queries.

Assessment: It is not only based on the e-portfolio but also on its presentation.

Support: Switching from regular online consultations to meetings one week before the milestones and individual discussions on request.

◆ **Hardware**

Ready to use self-balancing two-wheel robot (developed and build at the UAS Kaiserslautern) with two brushless gimbal motors, an inertial measurement unit and an Arduino board (MKR WiFi 1010) as main components.

◆ **Software**

Mathworks Simulink with heavy usage of the following toolboxes: Simscape Multibody, Stateflow, Control Design, Design Optimization and Code Export.

◆ **Comparison with previous years**

In previous years, the first half of the semester (acquiring necessary competences) was not based on self-studies but on a mixture of lectures, software demos and tutorials covering the different fields of interest.

During the second half (working on improving the robot), students had to present their current state of work every 2 weeks. Assessment was based on the presentations and the related discussions.

◆ **Teaching Method**

Distance

Due to the pandemic, it was not possible to offer the semesters in presence.

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(WS 20/21): In the 1st XP2P semester, traditional lectures were largely omitted. At the beginning of the semester, an introductory event was offered via Zoom, in which the instructors introduced themselves and the concept of the XP2P lecture. Here, all components of the structure - peer-to-peer learning and the e-portfolio - were explained in detail. The goal here was to present the expectations to the students as transparently as possible. In addition, the students were able to get to know each other and make initial contacts to form groups. Students who were not interested in the structure of the lecture could switch to other courses at the beginning of the semester.

After the introductory session, no further joint appointments were planned in the large lecture group. Students were supposed to work out the lecture contents independently in their groups with the help of the available collateral. The students themselves could choose the group compositions; the teacher only supported students in finding groups if they asked for help.

The students were largely free in their work planning. They only had to orientate themselves to the given milestones (see Table 4) and submit their e-portfolios by the specified deadlines. The introductory and closing reflections mentioned in Table 4 were voluntary and served only as support for the students. They could be used to get to know the Mahara platform, to get feedback from the teachers and to share their own opinion about the concept of the XP2P lecture.

In the progress of the lecture, the students could use the regular digital consultation hours of Mr. Mäurer and Ms. Zingraf. They also could ask questions in the forums and chat functions of the Mahara lecture group and enter into discussions with fellow students and instructors.

After completing the last mandatory milestone, students were assigned three random e-portfolios of their peers. They had then to work through these e-portfolios and formulate constructive feedback on them. They were free to choose their own focus; they just had to show that they had engaged with their peers' work. The students could post their criticism either anonymously or with their real names in the comments of the e-portfolios. This was intended to reduce their fear of getting into conflicts with fellow students or being dishonest for fear of them.

(WS 21/22): In the following semester, the concept was largely continued as before. However, additional presentation dates were introduced on which the entire lecture group met digitally to view the e-portfolios of the individual students. In their presentations, the students were able to present their own progress and procedures, and they were able to address challenges and problems. In addition, they were able to gain an insight into the approaches of all students and thus receive new impulses for their own work.

Presence

Due to the pandemic, it was not possible to offer the lecture in presence. While the 1st XP2P semester had to take place completely online, at least the introductory event in the 2nd XP2P semester could be offered in presence. Here, the students could get to know each other and already establish contacts for group formation.

Support

Regular consultation hours were introduced to support the students. For technical questions and problems, students could make use of the consultation hours of Mr. Mäurer. For questions about the e-portfolio and the platform Mahara, Ms. Zingraf took over the consultation.

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The consultation appointments were offered online via Zoom. Students were able to join without prior registration on the announced dates, ask questions and get into an exchange with the staff and fellow students.

Groups were created for the lectures on the e-portfolio platform Mahara. Here, students were able to network and share with each other, access lecture materials, and submit e-portfolios to instructors.

To help students understand the e-portfolio method, an example e-portfolio was created to transparently present explanations and expectations to students (See the documents of Intellectual Outputs 3 and 5 for further information).

◆ Promoting P2P-education

Project-based learning was used to promote *reciprocal peer-learning*: As already mentioned, project-based learning is an active pedagogical method that allows students to learn through the achievement of concrete projects¹⁸. These projects involve challenging and authentic tasks that have references to real work situations^{19, 20} and extend over time²¹. Through this type of work, students can gain greater autonomy, confidence and trust in their abilities, feel less judged than in the presence of the instructor, learn to negotiate, and they can be at the centre of the learning process.

In addition, as explained above, the e-portfolio platform **Mahara** was used to promote and facilitate *reciprocal peer-learning* and *peer-assessment* during the course.

For the purpose of *peer-tutoring*, an **assistant** was also employed who was both a project staff member and a master's student. Due to his parallel roles, he was able to act as an optimal link between the teachers and the students since the students could accept him as an equal point of contact.

II.1.3. Results of semester project

◆ Assessment (of the students' work)

The lecture was assessed in the 1st XP2P semester using the e-portfolio. In the 2nd XP2P semester, in addition to the e-portfolio, the presentations on the milestones were also included in the assessment. In the 1st XP2P semester, the criteria of the engineering way of working as well as the presentation of the learning process and progress were primarily decisive for the assessment of the e-portfolios. It was transparently explained to the students that the concept was new to the instructors and would not negatively affect their grading. Based on the results of the 1st XP2P semester, a grading scheme was then developed for the 2nd XP2P semester (see Appendix 4). This was presented to the students and discussed with them at the beginning of the course. During the course, the students could access the evaluation scheme at any time.

¹⁸Perrenoud (1999). Apprendre à l'école à travers des projets : pourquoi ? comment ? Faculté de psychologie et de sciences de l'éducation, Université de Genève. http://www.unige.ch/fapse/SSE/teachers/perrenoud/php_main/php_1999/1999_17.html

¹⁹Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving schools*, 19(3), p. 267-277. <https://doi.org/10.1177/1365480216659733>

²⁰Solomon, G. (2003). Project-based learning: A primer. *Technology and learning-Dayton*, 23(6), p. 20.

²¹Gary, K. (2015). Project-based learning. *Computer*, 48(9), 98-100. <https://doi.org/10.1109/MC.2015.268>

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◆ Evaluation (of the method)

Qualitative survey methods were introduced for feedback from teachers and students. Students were invited to write their feedback on the course in the closing reflections of the e-portfolios and were free to choose their own focus. Questionnaires with open-ended questions were created for teachers and staff to answer in (group) interviews. Since the format was new for the project team involved, this type of survey was deliberately chosen in order not to steer or distort the answers in certain directions. In this way, the multi-layered subjective views of the students and teachers could be elaborated and new perspectives and impulses for the project could be revealed.

◇ Student perspective

- ☞ The intensive group work was positively highlighted by almost all students in the reflections.
- ☞ Students had the feeling of gaining practice-oriented skills.
- ☞ Flexibility to accommodate students' individual situations was gratefully acknowledged.
- ☞ Particularly positive given the pandemic situation: students were also able to collaborate digitally.
 - International students who had to stay in their home countries due to the pandemic were happy to be able to participate digitally in the course, but had to cope with various challenges (e.g. time differences).
- ☞ Continuous feedback from the teaching staff was appreciated.
- ☞ Peer assessment was positively received, as new perspectives could be introduced.
- ☞ Dividing the lecture into milestones was helpful for students to organize themselves.
- ☞ Regular consultation hours of the staff were found to be helpful.
 - Students have requested that these consultation hours align with milestone dates.
- ☞ High time consumption was criticized since much of the content had to be worked out by the students themselves.

◇ Staff perspective

- ☞ Mandatory meetings in P2P courses can be greatly reduced.
 - An optimal working method is achieved when students remain in the group work for the most part and there are only meetings of the whole course group for intermediate presentations.
- ☞ If students can choose their own groups, this tends to create highly homogeneous groups that find it difficult to get beyond their own personal limits.
 - Teachers must either determine the group compositions.
 - Or create better opportunities for students to receive more outside stimulus to be successful even in homogeneous groups.
- ☞ Lack of shared physical work/learning spaces due to the pandemic.
 - It has slowed down P2P efforts and prevented exchange beyond one's own group.
 - Problems & backlogs are more likely to be noticed through regular exchange with the assistant, who has a better connection to the students due to his position.
- ☞ Concept must include intercultural differences and leave choices open which can be adapted to the individual groups (e.g. more or less structuring of the lecture).

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II.1.4. Conclusion and suggestions for improvement

Overall, the format was well received by the students. **Especially the possibility of peer-to-peer learning in connection with the project-based work was highly appreciated by the students.** This gave them the impression of being in a real-life work situation and they could take responsibility for their own learning. Difficulties arose for the students especially through the e-portfolio work: It was a new concept for them, and they were partly overwhelmed with having to write reflexively and using a new platform.

The following suggestions for improvement can be drawn based on these two XP2P semesters at HSKL.

- ☞ The assessment workload for instructors needs to be reduced.
- ☞ The evaluation scheme needs to be more specific to the lecture.
- ☞ Since lectures have been reduced as much as possible in this format, it is necessary to create learning spaces instead where students can meet and exchange ideas outside of their own group.
- ☞ This proposal is theoretically easy to implement but was not possible due to the pandemic.

II.2. Experience implemented in the lecture “Transfer module “Lightweight Design”

This experience relates to the course “Lightweight Design”. It was offered as “transfer” from the experiences gained after the first mechatronic semester. The course was specifically redesigned for this purpose as a so-called “Learning pathway”-course.

II.2.1. Students involved

- Number: 16 (fifth-semester bachelor’s students), of which 1 female and 15 male.
- Nationalities/Background: All students had obtained their university entrance certification in Germany.
- Previous Experience with mechatronics: None, Bachelor students in Lightweight Design course.
- Previous experience with P2P-education: None.

II.2.2. Semester assignment:

As a “Learning pathway”-course, the individual assignments within the course are handled sequentially after the previous was finished successfully. Roughly, the assignments consist of

1. Entrance Reflexion.
2. Shear Force and Moment Load Distribution (a fresh-up and extension of a previous course).
3. Estimating the deformation of a complex construction (students need to make assumptions and apply basic rules to simplified geometries).
4. Buckling (design the lightest solution of an ideal beam loaded in compression, considering buckling and denting).
5. Design and build a paper beam that is loaded in 3-point bending.
6. Intermediate reflexion followed by
7. A “semester project” to design, build and test a lightweight C-bracket beam. Finally, the semester was finished by
8. A final reflexion.

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◆ **Tools/Methods**

Students received a set of carefully constructed assignments to stimulate and motivate them to work in a P2P-group-work-setting. The students applied scientific methods obtained in previous courses. The self-controlled group work was accompanied by several short lectures (30 minutes) on selected topics to give extra structure to the assignments and to clarify relevant aspects to be included in the results.

◆ **Hardware**

Pocket calculator/Laptops

◆ **Software**

Repeated calculations (often optimisations) were usually performed with EXCEL. Some students included Finite-Element-calculations (Ansys Workbench), but this was regarded as optional, as learning to work with the software was scheduled for the same semester. The assignments were distributed via the learning management system OLAT (Figure 13). OLAT was also used for handing in the reports, due to its possibilities to facilitate time windows for the response. Mahara was generally used for documentation of the learning progress and thus as a basis for exchange with peers and teaching staff.

Figure 13: screenshot of the course “Lightweight Design” (OLAT)

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◆ Comparison with previous years

The delivery method of the course was quite different from the previous years, so a balanced comparison is hardly possible. Main differences were the introduction of a completely new “Learning-Pathway”-course, that gave extra structure to the different assignments. Second, students were presented with the concept of P2P-learning at the beginning of the semester and were made clear that they shared responsibility for the learning outcomes of their fellow students. This concept is unusual, both for the students as well as for the teaching staff involved. Third, the assessment criteria were communicated at the beginning of the semester, which clearly helped to “ease” the students over their participation in this trial.

Inhalt	Themen- und Zielstellung der Arbeit ist genau beschrieben und präzisiert.	Themen- und Zielstellung der Arbeit ist beschrieben und präzisiert.	Themen- und Zielstellung der Arbeit ist allgemein beschrieben.	Themen- und Zielstellung der Arbeit bleibt vage.	Themen- und Zielstellung der Arbeit ist nicht beschrieben.
	Einbezogene Quellen (z.B. Praxisbeispiele, Literatur, empirischen Daten) unterstreichen die Argumentation und dienen der Beantwortung der Fragestellung.	Einbezogene Quellen (z.B. Praxisbeispiele, Literatur, empirischen Daten) unterstreichen mehrheitlich die Argumentation und dienen der Beantwortung der Fragestellung.	Bezug der einbezogenen Quellen (z.B. Praxisbeispiele, Literatur, empirischen Daten) zur Argumentation in einigen Fällen nicht ersichtlich, Relevanz für die Beantwortung der Fragestellung bleibt vage.	Bezug der einbezogenen Quellen (z.B. Praxisbeispiele, Literatur, empirischen Daten) zur Argumentation wird kaum hergestellt, Relevanz für die Beantwortung der Fragestellung ist nur angedeutet.	Einbezogene Quellen (z.B. Praxisbeispiele, Literatur, empirischen Daten) weisen keinen Bezug zur Argumentation und zur Beantwortung der Fragestellung auf, fehlerhafte Quellen werden einbezogen.
	Das eingereichte E-Portfolio ist inhaltlich vollständig und beinhaltet Nachweise für alle Ergebnisse, ebenso wie die Eingangs- und Zwischenreflexion.	Das eingereichte E-Portfolio ist inhaltlich weitestgehend vollständig und beinhaltet Nachweise für alle Ergebnisse.	Das eingereichte E-Portfolio ist inhaltlich nicht vollständig; es fehlt der Nachweis für einige Ergebnisse.	Das eingereichte E-Portfolio ist inhaltlich nicht vollständig; es fehlen Nachweise für mehrere Ergebnisse.	Das eingereichte E-Portfolio ist inhaltlich nicht vollständig; es fehlen angemessene Nachweise für alle nahezu alle Ergebnisse.
	Das E-Portfolio weißt, ausgehend vom zu erwartenden Kenntnisstand, eine logische Argumentationskette auf. Die Ergebnisse sind vollständig, ausführlich und differenziert dargestellt und diskutiert. Die Arbeit bearbeitet die Problemstellung (im Rahmen der Möglichkeiten) umfassend.	Das E-Portfolio weißt, ausgehend vom zu erwartenden Kenntnisstand, eine weitestgehend logische Argumentationskette auf. Die Ergebnisse sind explizit und nachvollziehbar dargestellt. Die Arbeit behandelt die Problemstellungen.	Das Portfolio weißt in Teilen Fehlschlüsse in der Argumentationskette auf. Die Ergebnisse sind nicht immer explizit und nachvollziehbar dargestellt, es finden sich ggf. Lücken hinsichtlich einzelner Aspekte.	Die Argumentationskette weißt deutliche Fehler auf, die vielen Fehlerbereichen zuzuordnen sind. Die Ergebnisse werden nicht nachvollziehbar dargestellt oder beziehen sich kaum auf die Problemstellungen.	Die Argumentationskette zeigt schwerwiegende Fehler auf. Die Ergebnisse werden nicht dargestellt oder beziehen sich nicht auf die Problemstellung. Es wird ersichtlich, dass der/die Studierende deutliche Wissenslücken in Bezug auf die Vorlesung hat.
erreichte Punkte:	4	3	2	1	0
Reflexion & kritische Auseinandersetzung	Eigenleistung der/des Studierenden ist klar ersichtlich.	Eigenleistung der/des Studierenden ist ersichtlich.	Eigenleistung der/des Studierenden ist in Teilen der Arbeit ersichtlich.	Studierende orientieren sich zum Großteil an der Leistung anderer.	Keine Eigenleistung der/des Studierenden vorhanden.

Figure 14: excerpt of the assessment table (4 pages in total). The table was chosen as basis and altered to fit the requirements of “Lightweight Design”. Major changes will be made for the next semester

◆ Workflow

The first assignment to the students was to write a self-reflection on their previous knowledge and experiences as well as on their expectations for the course “Lightweight Design”. After completing the first “preparative” assignments and before the start of the final “semester project”, students were asked to write an intermediate self-reflection. The latter was substantially improved in comparison to the first, as students understood better, what was the sense of this exercise. To achieve this, it was important that each student had received personal feedback on their first self-reflection and also, to have received detailed advice on how to further develop and improve this learning instrument.

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◆ Teaching Method

The course was delivered in presence in the Laboratory for Lightweight Design. This enabled the students to perform some simple handwork, make models and leave them in the lab, and perform tests at the universal testing machine if desired. In most cases, there was no central lecture scheduled, so students could come and go as they pleased. Generally, they used the time slot effectively as an opportunity and place to meet, and to ask questions to the staff, if needed. General feedback to the handed-in assignments were given both individually and – for more general feedback – in classroom.

Support

Use of e-portfolio/Mahara

Ms. Zingraf provided the students with access, all necessary information and support to Mahara. Especially in the first weeks, support was needed to grant access for all, make the students familiar with the software and also to make them use Mahara. In a few cases, it needed a fixed deadline to make students start to describe their results in Mahara and to comment on the work of the other students.

◆ Promoting P2P-education

For the teaching staff, the unknown factor was whether the students would accept the learning method or object to it e.g., because of privacy reasons. For engineering students, it is not common to write self-reflections or e-portfolio contributions and allow fellow students insight into their thinking/process. Students were assigned to four groups of four, so that every student had to share their e-portfolio with at least three other students. This connection between these students remained during the whole semester. Most assignments were performed in groups, for which the students could choose their fellows themselves. Also, the final “semester project” was performed in groups of 3 to 4, which the students formed themselves.

In this manner it was achieved that students could do their project work with fellows that they themselves chose to work with, but their e-portfolios were read and commented on by fellow students that were chosen by the teaching staff. This was an important feature to open up existing social structures.

II.2.3. Results of the semester project

As the topic of this assignment changes every year, there is no direct way to compare the learning outcomes of this semester to the previous years. On the other hand, after having given this course over the past 25 years, there exists a finely-tuned experience in what can be expected.

The Shear-Force and Moment Load distribution was performed as usual. For the (newly attributed) exercise in estimating, there was a large spread in the quality and quantity of the work delivered. On the positive side, three students surpassed every expectation the teacher had made before: very thoroughly made, critical, making good use of the available theory. Most students performed in an average manner, another three students (a group of friends) performed below the expectation, which gave the opportunity to address that behaviour in an early stage of the semester.

The Estimation-exercise led, at first, to perturbed impressions with the students, as they are so accustomed to assignments with a defined answer. In this case, the exact answer was not known. It helped the students to work together and make their “educated estimation”. A truly false answer could not be given: at most, it was an unrealistic answer.

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The Buckling-design- exercise was performed better than expected. There is a single optimal answer and the majority of the students found it while some came close.

The paper-construction was performed with great enthusiasm. As an introduction, an almost pure shear loading was demonstrated on a piece of ordinary copying paper and it strikes the students to see that a healthy young student is hardly able to tear the paper as long as pure shear loading was applied. The academic result however was not good enough. The students did not apply the necessary theoretical background. In the coming year, this exercise will be adjusted and will consist of *two* cycles: the first one will be as performed last semester. The students will then describe the outcome of all tested beams and then in a second cycle they will have to produce an optimised beam.

As mentioned previously, the intermediate self-reflection made a more differentiated impression and obviously served the learning process better than the first one (where there was still too little known about self-reflection).

The final “semester-project” was well-performed, over average judged on a long-term scale, and a positive learning atmosphere seemed achieved.

◆ Assessment

From a teacher’s perspective, the assessment was a challenge. First, for sixteen students, the amount of material to be reviewed was extreme. Most students found meaning in traceably describing their work, the alternate ways, their choice, the pros and cons. They were encouraged to work on their e-portfolio also *after* they had handed in their assignments. This was obviously the case because peer-comments to the reports were only possible *after* they had been completed and handed in. Although teaching staff had read and commented on the single hand-ins during the semester already, final assessment needed another turn through all sites and artefacts. This work needs to be reduced in the future. Second, the learning progress of the individual students was on quite different levels. Partly they had concentrated their reporting on different aspects of the assignments, thus addressing topics of different complexity. To honour those differences in a fair and transparent grading was regarded as a challenge too. The assessment table produced and communicated to the students at the beginning of the semester (Figure 14) did not rightly cover the width of the work to be assessed, so a modification is due.

◆ Evaluation

◇ Student perspective

Because of the trial character of P2P-learning and the use of an e-portfolio-assessment in this semester, it was decided to start the survey at the end of the semester and *after* the grades were announced to the students. During this time, in February, students are usually not present at the university campus and feedback is thus typically very limited. A SurveyMonkey-questionnaire was sent to the students’ e-mail-addresses and they could – of course – send their comments anonymously. All comments received are mentioned below (translation into English by DeepL). The answers below are just different items in MonkeySurvey. For the coming year, knowing better where to look at, it is planned to set up a more detailed questionnaire.

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What did you find positive in my lecture on lightweight design?

- I liked the fact that you had to deal with the content in depth. Both for the assignments that were handed in and for the e-portfolio in general. That's why I have the feeling that the content stuck better. The fact that you could try out a lot yourself reinforced this effect. I also found it very positive that we could construct, build and even test something ourselves, so you learn more than in purely theoretical lectures.
- Structure, topics, help from the lecturer, motivation
- The relatively free handling, the practical exercise and examination, proximity to students, helpfulness, explanations.
- The independent work and solving of complex tasks. The "freedom" in constructive tasks. The kind of "competition" in the exams. And finally, that it is not bad, if e.g. the beam or the c-frame failed much earlier than thought or calculated, and it went for it more on the knowledge drawn from it.
- Moodle, examination form e-portfolio, learning effect, teamwork.
- The whole lecture had a red path, each week had a value for the final work.
- Own thoughts about tasks with a help support from you, freedom of construction, lecture tied with practical tasks.
- What struck me most positively was the lasting learning effect of this course. By creating the e-portfolio, one was virtually "forced" to acquire the material week by week, topic by topic, already during the semester. This is definitely more effective than "ironing in" all the material at once a few weeks before the exam. In addition, you don't lose the connection through constant smaller submissions.

What did you find negative in my lecture on lightweight design?

- At the beginning of one or the other task, the benefit of it was not immediately obvious and you wondered whether this task makes sense, but the sense of the task came during its development, therefore, no negative criticism here.
- I can't think of anything.
- I have been very satisfied with the lecture. I learned a lot and even in a "playful" way. The only thing that could be optimized in my opinion is the scheduling of the theory lectures. Often the hours were intended for the construction of the beam or the same and only 20 min lecture. These have then usually drawn out much longer which has brought one in the end in predicament for the completion of the previously thought or planned work.
- No ZOOM session.
- The self-reflections were not easy to write.
- No midterm reflection but only a mandatory final reflection.
- Not necessarily negative, because mostly unavoidable in the study, was that the regular tasks sometimes overlapped with tasks in other subjects. This was then unfortunately sometimes a bit "stressful" because of course you wanted to do justice to both subjects and accordingly invested a lot of time.

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◇ Staff perspective

The P2P-learning method in combination with e-portfolio assessment was new and by 2021 not covered automatically yet by the examination requirements. The trial above was approved for two years. Meanwhile, the examination requirements have been changed such that this way of organising the course can continue without restriction.

The results of the single assignments – from a staff perspective - are already mentioned above. Overall spoken, it was a first trial and a number of necessary adjustments will be made before the next trial. Interesting in this respect is that after having experienced the first run of the mechatronics semester more or less as a by-stander (the teacher was not a mechatronics expert himself), this first trial in “Lightweight design” showed still a number of “beginner’s problems” that can only be experienced by “drinking the cup”. Nevertheless, the results of the first semester in Mechatronics yielded a valuable framework to offer an acceptable transfer semester from the start.

II.2.4. Conclusion and suggestions for improvement

A course “Lightweight Design” was given to 5th-semester Bachelor’s students in Mechanical Engineering/Mechatronics. The preparation of this course was supported by previous experiences as a spectator to the first run of the mechatronic semester within the project XP2P. It showed that these “foreign” experiences are very helpful to optimise the transfer to other courses. On the other hand, it needed indeed a “trial semester” and own experiences within a familiar course to be able to deeply understand the challenges and impact of P2P-learning and e-portfolio-assessment. The results of this first “trial semester” are very promising from the perspective of both students as well as teaching staff. The learning method in this module will remain – with further optimisation necessary - P2P-learning and e-portfolio-assessment.

In order of importance, the following need for improvements was experienced:

- ☞ Improve the assessment so that repeated reading and search for changes is reduced.
- ☞ Replace the short lecturing inputs to instruction videos combined with personal contact windows (for questions/remarks).
- ☞ Align the assessment table more to the actual assessment.
- ☞ Provide more information on writing self-reflections (text and video on demand).
- ☞ Provide more detailed information on the assignments to remain even further in the background.

III. Practical implementation of peer learning semester/module in the master in Mechatronics at TUCN

The following paragraphs deals with the implementation of the teaching methodology aimed at during the XP2P project by the TUCN partner team in the framework of the master's programme in mechatronics.

III.1. Persons involved

As mentioned above, the XP2P project, or "Crossing borders: peer-to-peer education in mechatronics" aims to continuously develop students' social, teamwork and autonomy skills by learning - initially from the teacher and then from their peers - through group projects, e-portfolios, which are finally evaluated by the teacher.

Our main objective was to get students to use online platforms that allow them to work together and be part of a team, but also to stimulate them to collaborate to solve tasks.

How did we achieve this?

We introduced them to the concept of peer to peer and its main advantages; but also, how they can work together on different platforms. Once the implementation was successful and they started to familiarise themselves with the platforms, we closely observed their progress and their behaviour while working in groups. At the end, we wanted to analyse the involvement of the students by having them complete a feedback form

The project involved teachers from the mechatronics department, but also research assistants: Alexandru Oarcea; Victor Cobilean, Sergiu Stan, Miruna Peris, Emil Teutan

III.2. What were the assignments?

Students had two big assignments divided on the two semesters:

The first one was to work on a research theme. Each group received a study theme, but some teams also proposed their own one. They had one semester to write an essay about it and to be able to make a presentation where they presented the results and their findings. One semester consists of 14 weeks, but there were only 12 weeks for them to finish their research and their corresponding e-portfolio. The first week was used to present the themes to the students, to offer all the explanations needed, to answer their questions and divide them into groups of two students. The actual assignment consisted of researching about a given scientific theme and of writing an essay using Microsoft Word and having a certain formatting (paragraphs, spacing, fonts, etc.) so that they could get used to the template of scientific articles. Also, they had to make a PowerPoint presentation where they had to clearly explain the hardest and most interesting parts they faced while doing the research as well as how they divided the work. They were also encouraged to attach annexes, such as references, 2D drawings, CAD files, scripts etc. The Word file had to contain an Introduction, Objectives, State of the Art, System description (if it was the case), Implementation and/or Results, Discussion/Conclusion.

For the second semester there were two different subjects.

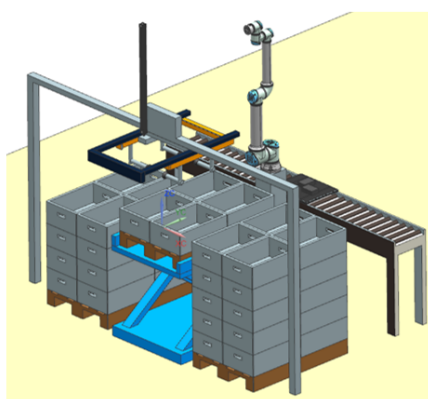
- For the first subject, the students had to work on a research topic again, but this time the teams were composed of 3 students instead of 2. The idea was that the themes were more complex from the mechatronics area. Each team member had to work on one of the three

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main elements of mechatronics: mechanical part, electrical part and the “soft” part (programming). The teams had to be very diverse, and they had to be able to develop a notion of responsibility. At the end, the process was like the one from the first semester. They also had only 12 weeks out of 14. An example of documentation written by 3 students about logistic systems and the impact of the Covid-19 global crisis is proposed in Appendix 5.

- The second subject- advanced MATLAB programming- had a different approach. In their e-portfolio, they had to report their progress using software and the simulations they carried out. The idea was to work on more mini projects using MATLAB Simulink, but also to start working with Arduino and Raspberry PI. They also had to learn to use 3D modelling software, like Solid Works, Catia, Delmia, etc. and to create the 3D model and simulation of a given industrial hall or process (example of result in Figure 15). At the beginning of each class, the students had to present their work to date. The theme/ applications were given to them by the teacher, and they had to do the offline programming and simulation of a robot. Each team had a different model (Fanuc, Kuka, UR, etc.) and they had to elaborate a technical report of their work. This consisted of some technical information about the robot and which steps they followed to finish their tasks. Also, they had to attach a video with the simulation and the actual program.



- Axa cinematica de transfer preia 4 cutii goale si le plaseaza pe un lift
- Robotul ia rasnitele, una cate una si le plaseaza in cutii
- Liftul coboara automat pentru a mentine cutiile la nivelul bazei robotului.

Figure 15: example of the result of a modelling activity

For all the tasks, students had documents uploaded on Teams - where they could find information, how to use Google Scholar and Google Academic, a template of the research paper, etc.

For the practical task of the second semester, many videos as well as important and useful information for the students were uploaded on the MAHARA platform so that they could access them as often as they wished and to help them into finishing their e-portfolios.

The evaluation of the e-portfolios consisted of checking the ability to write a research paper on a given theme, respecting the paper formatting and the topics. For the practical application, the students had to show the simulation and how they tried (if not succeeded) to solve the encountered problems. The presentation was also an important part of the evaluation. The way they structured their work and how they were able to work in a team was taken into account.

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Finally, given the fact that they had to review and give feedback on their colleagues' work, a paper with the feedback had also to be uploaded on Teams and it was taken into consideration for the final grade.

All the documents were uploaded in Microsoft Teams in the corresponding assignment. The teacher reviewed the achievements of the tasks and gave feedback to the students.

◆ Constraints placed on the students

The most important constraint placed on the students was the time constraint, but also the assignment of working with different people on each project and of improving their skills for given tasks. They only had 12 weeks and they had to ask questions regularly, during each meeting so that they could finish on time. Also, the teams consisted in the first semester of two members and each of them had to show their work. The second semester had a more complex research theme and practical work. They had to divide their tasks in a very well and balanced manner. They also had to be able to review their colleagues' work and help each other if necessary. Constraints regarding time management were vital in finishing the tasks. Also, they only had max.10 minutes to present their PowerPoint, so the results had to be clear and concise.

Another difficulty was the inability to find information regarding their research theme or their robot. They had problems regarding uploading their e-portfolio and learning how to use Microsoft Word and different platforms of software, such as MATLAB, SIMULINK, etc.

◆ Composition of the student teams

The teams were composed based on the students' skills, so that they would be able to complete the tasks given and so that the large diversity of the group allowed them to learn from each other. Also, one of the goals was for them to exit their comfort zone. For example, they had to learn how to make a presentation even though they may not like speaking in public.

For the first semester, the teams were composed of two members so that each of them could contribute substantially to the research.

In a random way, some e-portfolios of a given team were distributed to other teams so that they could also write a short review using the peer-review method. In this way, they could see some of the mistakes or good things that their colleagues did, learn from them and apply everything to future work.

In the second semester, for the first subject (a more complex research paper), the teams consisted of 3 members. Within each group, the students had to choose who was going to work respectively on the mechanical, electrical and programming parts. For the advanced MATLAB programming task, the students were in teams of 2-4 members. They all had to learn how to do a rather complex simulation of one of the robots/equipment present in the lab.

◆ What kind of peer-to-peer learning activities took place?

Reciprocal peer tutoring has been implemented, where students are changing their status from students to teachers.

Also, class-wide peer tutoring was experimented, where the whole class is divided into smaller groups. Each student in groups has a separate subtask, which is relevant to solving the given problem to the group.

Think-Pair-Share was another method used that consisted in the teacher giving a challenging question. First, the students think individually, then they discuss the solution with a group member.

The last method was the Discovery Method, which is a structured problem solving, where the groups are asked to find the information they need to solve the problem

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Other peer-to-peer exchanges took place during the project activities:

- ☞ The peer-to-peer exchanges occurring when the students presented their work at the beginning to each course help them develop their communication skills.
- ☞ For each mini-project, the students had to group in a different team: this improved their team-working skills.
- ☞ Each student needed to be at least once a team leader. Thus, they could also develop their management skills and see the requirements to be a leader.
- ☞ Each e-portfolio was uploaded on Microsoft Teams and the teacher sent each group an e-portfolio of another group for evaluation. Then, the team had to evaluate one of their colleagues' e-portfolio, to review it and give suggestions on how it could be improved.

◆ What was considered as a good e-portfolio?

To be considered as a good e-portfolio for the research theme, an e-portfolio needed to present a very specific purpose and a varied content on the subject. It had to be submitted on time, to be related to coursework and it had to provide an explanation of very complex themes. It had to include many references and to show that a very good documentation was carried out. Also, it had to show exactly how the students divided their tasks in the team. The paper had to be concise and to show relevant information about the topic.

All the constraints regarding the paper formatting and the contents had to be carefully taken into consideration as well as all the aspects discussed with the teacher during the semester.

For the practical part, the e-portfolio had to report about the simulation and software work and to contain a technical report. In the technical report, the e-portfolio had to present some information about the studied robot and details about the simulation and/or the program the team was going to create or created.

◆ How was the assessment carried out?

The assessment was carried out through students' presentation and evaluation of the e-portfolios. However, it was also very important to take into account how they evaluated and helped their colleagues feed their e-portfolios. Each week in the classes, the students had to present a short update on their state of progress regarding their research or projects. The teacher took notes based on what they did and reported and offered them different suggestions or answered their questions. Based on their activity and commitment, the students received temporary marks which were considered in the calculation of their final grade. Also, no copy-paste was allowed, they had to present formulas, calculations and a cursivity of the paper.

◆ What challenges arose?

- ☞ Some students did not complete their individual tasks, and some were not interested in finishing the project, which affected the whole group.
- ☞ Some themes were maybe more complex than others, so the corresponding groups did not have enough time to finish their research.
- ☞ For some research topics, the students also didn't find much information, or they did not have an institutional account to access the complete papers. They had then to ask the teacher to download some of the papers for them.
- ☞ For some groups, the students had problems with getting along with their teammates. Some of them were not very compatible or did not find a way to communicate and divide tasks.

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It was also hard for some students to respect the notion of responsibility so that they could finish a given task in a specific timeframe.

◆ How do lecturers reflect on the implementation?

The lecturers encountered difficulties to structure all the materials for the presentations, to help students start using the peer-to-peer concept and to stop using the traditional teaching method.

Also, they found it hard to show the students how and where to find useful information. Finding the relevant resources for the topic documentation and suggesting it to students was indeed a major challenge in order to have relevant research that could have important contributions in the topic.

Another difficult task was to show the students how to work using MATLAB and other CAD-software and how to divide their work within the team.

An important task was the organisation of teamwork so that every student had the opportunity to be a team leader and the chance to participate in a peer-learning process.

Finally, another challenge was teaching the students how to use Microsoft Word and Teams in a more complex manner.

◆ How do students reflect on the implementation?

After the feedback forms were collected, 90% of the students were satisfied with how the class was structured and enjoyed working in groups. Their feedback was positive and the fact that they experimented with a new learning method was also interesting and challenging for them. Being in the position of team leader helped them get over some fears and constraints they had.



IV. Discussion and conclusion

Within the framework of the XP2P project, the three partner universities have integrated new teaching and learning methods in engineering. The example of mechatronics has been used to study the influence of peer learning associated with an e-portfolio on the acquisition of competencies by students. The project is based on the belief that peer learning, i.e. learning with and from others, is one of the most effective forms of learning to strengthen informal learning and promote self-learning skills. Since the peer learning process requires that the role of teachers evolves to become moderators and facilitators, it was necessary to monitor the process and provide students with guidance support. Therefore, it was decided to use an e-portfolio to document the students' learning process, to allow them to critically reflect on their own learning process and to give teachers the possibility to intervene in a targeted way where help was needed.

The e-portfolio, combined with peer-to-peer learning, was intended to help students develop deeper transversal and technical skills.

The concepts used in the project are related to the field of mechatronics and engineering, but one of the objectives of the project is also to be able to generalise this approach for undifferentiated use in higher education.

Threats

Shortly after the beginning of the project implementation, the Covid-19 outbreak totally stopped the world economy and the travel within each country and between countries.

This pandemic obviously affected the XP2P project and its implementation within the three partner universities but also in the exchanges planned between the team members and also between students. The meetings and events that we had planned to organise could not take place as we had envisaged and the trips of the students to the partner universities could not take place as we had hoped. Nevertheless, we were able to continue the project by finding alternative methods and testing new tools.

Opportunities

The changes brought about by the Covid-19 epidemic on the way of working were also a great opportunity to test new tools and to be innovative in the teaching methods used.

The use of the eportfolio in this context has certainly allowed for better monitoring of student work and learning. Collaborative work has been strengthened and this tool has made it possible to introduce new modes of communication between students and with teachers.

This crisis has also allowed the teams to improve their communication at a distance and perhaps also to collaborate more thanks to the use of collaborative work tools such as Framapad for the minutes of meetings for example. This was also an opportunity for teachers to propose pedagogical activities implemented in the LMS of partner universities. New pedagogical perspectives were then opened and the XP2P project allowed an additional help for the teachers by proposing them to use methods such as peer learning or the use of the eportfolio, which allowed them to remain effective in their teaching.

Strengths

Some teachers got involved in this project in order to work on the competency-based approach and peer learning. [For some of them](#), this was very motivating for the future and very effective, whether for technical subjects or general subjects such as English.

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The implementation of this project was also an opportunity for some teams to think more deeply about the tools to be used within their universities such as the LMS and eportfolio platform and a more global reflection than the XP2P project had initiated.

Mechatronics is a discipline that is well suited to the peer learning method, especially since the postgraduate courses of the partner universities welcome students from various backgrounds (electronics, mechanics, computer engineering, computer science, physics, etc.).

Weaknesses

The XP2P project has highlighted the fact that introducing innovative pedagogical methods such as peer learning and the use of an eportfolio in the framework of a competency-based approach requires a solid preparation of teachers and students at the beginning of the curriculum. Indeed, whether it concerns the students or the teaching staff, training and support in the use of tools such as an LMS platform or an eportfolio platform is necessary to enable optimal learning.

Moreover, the methodology of group work and project mode should be discussed with the students at the beginning of the training to allow them to lose as little time as possible afterwards.

The reduction in freedom of movement within the framework of the various confinements linked to Covid-19 did not allow for the exchanges between students that had been envisaged at the beginning of the project. Furthermore, some events that were planned to take place in person, such as multiplier events or training courses between universities, could only be carried out online.

The time spent by the teaching staff in implementing peer learning activities, enabling students to make optimal use of an eportfolio and enabling them to understand the competency-based approach has been significant. If the teams do not have the time that would be necessary to carry out these tasks in an optimal way, it can be very difficult to deploy these methods, despite the interest that teachers may have in the subject.

Prospects

In our experience, it seems that the collaboration as well as the active and motivated involvement of several actors are necessary for the implementation of innovative pedagogical methods to be successful for the students, especially in the framework of a multicultural and European project.

The governance of the universities must allow for this mobilisation of teachers, educational engineers, computer specialists and professionals working in conjunction with the universities.

The experience has shown that the uses were different according to the teachers and countries and according to the LMS platforms already in place in the programmes.

The very frequent meetings and exchanges between the teams of universities involved in the XP2P project have enabled the sharing of experiences and the continuous improvement of the educational activities implemented. The project has also contributed to strengthening the links between the university partners.

Based on this experience, we believe that the deployment of this approach must be based on a strategic vision of the universities in the European area with regard to the field of the valorisation of student learning. This approach to valuing skills, particularly through the use of the e-portfolio, should enable students to transfer their knowledge within a university to the world of work in a neighbouring country²².

²² Heutte, J., & Jézégou, A. (2012). La démarche eportfolio dans l'enseignement supérieur Français: Premiers retours d'expériences et proposition de clarification. Communication présentée au 24e colloque de l'ADMÉE-Europe, Luxembourg.

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The Bologna process requires higher education to focus more on the acquisition of competences. However, everyday university life is still often oriented towards standardised assessments of knowledge, whose marks do not allow conclusions to be drawn about the transfer of learning and the competences actually acquired by students²³.

The XP2P project was an opportunity to introduce the competency-based approach by using peer learning, project-based learning and eportfolio in postgraduate courses in Mechatronics in 3 master programmes of 3 European universities. The corresponding teaching teams worked collaboratively to continuously improve the quality of the teaching offered to their students in order to reach success. In many ways, this project was a success as it proved the possibility of mutual enrichment between students and teachers and between pedagogical and technical teams from different countries. It showed the possibility of learning in a different way and teaching in an innovative way by building on the students' competences and allowing them to become central actors of their learning.

²³ Stratmann, J., Preussler, A., Kerres, M. (2009). Lernerfolg und Kompetenz: Didaktische Potenziale der Portfolio-Methode im Hochschulstudium. Zeitschrift für Hochschulentwicklung, 4(1).

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Appendices

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Appendix 1

Course about PhD studies and research funding

Moodle Workshop Workshop about cover letter and CV for a research position

Assessment form

Aspect 1

CV SPELLING

Respecting spelling requirements in your resume is important. First, it gives an indication about your level in the language but more importantly, it gives information about your concern for details.

Thus, the resume (CV) must be without any spelling problems (grammar, typing error...).

As an example, interesting information about the importance of spelling mistakes in a resume can be found [here](#).

Assessment guidelines:

Grade 0: There are more than 3 spelling mistakes.

Grade 2: There are no more than 2 or 3 spelling mistakes.

Grade 3: There is only one spelling mistake. Grade 4: There are no spelling problems.

Grade for Aspect 1

Choose...

Comment for Aspect 1

.....

Aspect 2

CV LAYOUT (1/3)

The layout of your CV is important: the reader should feel like reading further the document after having a first glance at it. The size of police fonts must be large enough but not too big.

Assessment guidelines:

Grade 0: The size of police fonts is too big or too small or information is not properly structured or not properly distributed.

Grade 2: The size of the police fonts is adapted.

Grade for Aspect 2

Choose...

Comment for Aspect 2

.....

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Aspect 3

CV LAYOUT (2/3)

Information must be well structured and distributed in the page, with not too dense paragraphs.

Assessment guidelines:

Grade 0: Information is not properly structured nor properly distributed in the CV

Grade 2: Information is properly distributed in the page but not properly structured.

Grade 3: Information is properly structured in the page but not properly distributed.

Grade 4: Information is properly structured and properly distributed.

Grade for Aspect 3

Choose...

Comment for Aspect 3

.....

Aspect 4

CV LAYOUT (3/3)

Adding a photo in a CV is not compulsory. If you decide to add one:

- Its size must be adapted→ usually, it is about the size of an identity photo (a bit smaller than a passport one).
- The background must be correct (a neutral background is to be preferred, for example, no seaside, holiday or festive background).
- Usually, only the face appears.

Note that you can add a link to your LinkedIn profile where people can see your photo (hints about photo in your LinkedIn profile [here in French](#) and here in [here in English](#)).

Assessment guidelines if there is a photo:

Grade 0 if the photo does not meet all the above requirements.

Grade 1 if the photo meets all the requirements.

Grade for Aspect 4

Choose...

Comment for Aspect 4

.....



Aspect 5

COMPETENCES AND SKILLS PRESENTED IN THE CV)

The reader must easily know what you are able to do, that is the competencies and skills you have.

They must be consistent with the sections about your education, professional experience (and possibly hobbies).

They must not be presented only as statements but completed by brief information attesting how they have been acquired.

See for example : [How to describe your skills in your CV](#)

Remember that you must be able to explain everything you write in your CV in a job interview. You may be asked to describe a situation where you had to develop or apply a given competency or skill.

Assessment guidelines:

Grade 0 if none of the above requirements are met.

Grade 2 if only the requirement 1 is met.

Grade 4 if only requirements 1 and 2 are met.

Grade 6 if the 3 requirements are met.

Grade for Aspect 5

Choose...

Comment for Aspect 5

.....

Aspect 6

EDUCATION (CV)

In the education section, you must give:

1. the title of the degree
2. the awarding institution (with its location: country and possibly city)
3. the graduation year.

It is often recommended to present your degrees in a anti-chronologic order (give first the last degree you obtained).

Assessment guidelines:

Grade 0 if none of the above requirements are met.

Grade 1 if information is missing.

Grade 4 if no information is missing.

Grade for Aspect 6

Choose...

Comment for Aspect 6

.....

Aspect 7

PROFESSIONAL EXPERIENCE (CV)

The professional experience (mainly student jobs and internships for most of you) allows the reader to know what you have been doing, where and when. Thus you have to give:

1. dates (and/or duration if it is a brief experience)
2. company
3. location
4. position, main occupation, and achievements if any.

Note that the given information must be consistent with the section about competences and skills.

Assessment guidelines:

Grade 0 if none of the above requirements are met.

Grade 1 if information is missing.

Grade 4 if no information is missing.

Grade for Aspect 7

Choose...

Comment for Aspect 7

.....

Aspect 8

HOBBIES (CV)

The "hobbies" section must bring new and valuable information about you. It is not worth writing a vague hobby such as just writing "cinema" or "reading" or "biking". What interests the reader is to have an idea about your open-mindedness, your sociability, your possible involvement in an association (care, sport, study...), etc.

Your hobby can also prove some of your soft skills (team spirit, toughness, thoroughness, self-organisation...).

It is not compulsory to add this section in your CV but if it is the case, it must worth it because there is no place to waste in a CV.

Assessment guidelines is there is a hobby section in the CV to assess:

Grade 0 if hobbies are not given adequately at all.

Grade 1 if the section needs improvements. Grade 2 if the section is ok.

Grade for Aspect 8

Choose...

Comment for Aspect 8

.....



Aspect 9

COVER LETTER SPELLING

Respecting spelling requirements in your cover letter is important. As for the CV, it gives an indication about your level in the language but more importantly, it gives information about your concern for details. It is absolutely necessary to read several times your letter and to have it read by somebody else to correct all spelling issues. Thus, your cover letter must be without any spelling problems (grammar, punctuation, typing error...).

Assessment guidelines:

Grade 0: There are more than 3 spelling mistakes.

Grade 2: There are no more than 2 or 3 spelling mistakes.

Grade 3: There is only one spelling mistake.

Grade 4: There are no spelling problems.

Grade for Aspect 9

Choose...

Comment for Aspect 9

.....

Aspect 10

COVER LETTER LAYOUT (1/3)

As it is the case for the resume, the layout of your cover letter is important: the reader should feel like reading further the document after having a first glance at it. It is also a way to show that you take care of the reader. Using adequate police fonts and line spacing contributes to an appealing rendering to the cover letter.

Assessment guidelines:

Grade 0: The size of the police fonts or the line spacing must be totally revised.

Grade 1: The size of the police fonts or the line spacing must be improved.

Grade 2: The size of the police fonts and the line spacing are ok.

Grade for Aspect 10

Choose...

Comment for Aspect 10

.....

Aspect 11

COVER LETTER LAYOUT (2/3)

The paragraphs must be justified (same left and right margins, see in [this file](#)).

Assessment guidelines:

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Grade 0: Some paragraphs or all of them are not justified.

Grade 1: Paragraphs are justified.

Grade for Aspect 11

Choose...

Comment for Aspect 11

.....

Aspect 12

COVER LETTER LAYOUT (3/3)

Your contact information must be clear, as well as for the recipient of the cover letter.

You must write the place and date of the letter (for example: "Annecy, Friday 15th January, 2021").

Assessment guidelines:

Grade 0: The above information is not complete.

Grade 1: the above information is present in the cover letter.

Grade for Aspect 12

Choose...

Comment for Aspect 12

.....

Aspect 13

MOTIVATION

In a cover letter, you have to interest the reader. You must:

1. present your assets for it,
2. give additional information with respect to your CV.

Assessment guidelines:

Grade 0: none of the above requirements are met.

Grade 2: only 1 of the above requirements are met.

Grade 4: only 1 of the above requirements are met.

Grade 6: the 3 above requirements are met.

Grade for Aspect 13

Choose...

Comment for Aspect 13

.....

Aspect 14

LOGICAL ORDERING OF THE ARGUMENTS

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The way you write the arguments to support your application is an indication of how logically you organise your ideas. When you write out a letter draft, it is usual to write the ideas "as they come in mind, in a brainstorming way" but thereafter, it is necessary to organise them in logical sections.

Assessment guidelines:

Grade 0: the above requirement is not met → there is a lack of logic in the letter organisation.

Grade 3: the above requirement is partially met → The logical organisation of the letter can be improved.

Grade 6: the above requirement is met.

Grade for Aspect 14

Choose...

Comment for Aspect 14

.....

Overall feedback

Feedback for the author

A ▾
B
I

U
~~S~~
x₂
x²

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Appendix 2

Course about fundamentals of antennae
Screenshots of Moodle workshop implemented for master 1 students

Electromagnetism - Fundamentals of antennae

Disclaimer

This Moodle course is devoted to the fundamentals of antennae. It can be considered as a self-learning course. Among the activities, a Moodle workshop requires students to study the principles of GSM, WIFI and bluetooth communications on their own, and then assess the assignments of 3 classmates afterwards.



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 AnnouncementsFundamentals of Antenna Theory

(Contact teacher: Christine Galez, Université Savoie Mont Blanc)

We focus in this section on how electromagnetic waves are produced and how this production is modeled.

To have an insight on this topic, watch first this video from MIT Opencourseware and then answer quiz 1:



I recommend especially the final experiment.

Note that, for those of you who are interested in optics, the first thirty minutes of the complete video are dedicated to polarized electromagnetic waves, polarisers and wave plates. You will find the complete video and its transcript on [this](#)

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[webpage](#)

Note that, in all documents below, the cross product of 2 vectors will be written $\vec{a} \wedge \vec{b}$ that is $\vec{a} \wedge \vec{b} = \vec{a} \times \vec{b}$.

[Quiz 1 about the information given in the embedded video \(graded, deadline: 29/03/2022, 23:59, weight 2%\)](#)

[Forum dedicated to the Fundamentals of Antenna Theory](#)

This forum is dedicated to questions and answers about the fundamentals of Antenna Theory. The students are required to post their questions and can also contribute to the answers.

Read carefully the files below before answering quiz 2:

[Chapter 1 - Electromagnetic waves - Reminder](#) 277.6Ko

[Chapter 2 - Antennae - General considerations](#) 412.3Ko

[Quiz 2 about chapter 2 \(graded, deadline: 29/03/2022, 23:59, weight 3%\)](#)

The file corresponding to Chapter 3 is a problem you have to solve before the PHYS801 session with Christine Galez.

[Chapter 3 - Radiation sources - Variable electric dipole](#) 467.7Ko

[Chapter 3 - Radiation sources - Variable electric dipole - Solution](#) 369Ko

Accès restreint Non disponible à moins que :

- La date soit antérieure ou égale au **30 juin 2022** (caché sinon)
- La date soit postérieure ou égale au **4 avril 2022** (caché sinon)

[Chapter 4 - Antenna theory: a simplified approach](#) 519.6Ko

[Chapter 5 - Half-wavelength wire antenna - tutorial](#) 230.1Ko

The first page of the document (Chap. 5) gives the questions to be answered and the following pages give the solution.

Try to find the solution by yourself before looking at the solution.

Complementary documents to go further:

[Electromagnetism Lecture \(from J. Szarkis\)](#) 1.2Mo

[MIT OpenCourseWare - Audio/Video Lectures](#)

[MIT OpenCourseWare - Physics II: Electricity and Magnetism \(video\)](#)

Enrollment in the platform is necessary but it is free as long as you don't ask for a certificate.

[Antennas Analysis & Design](#)

[Antenna theory](#)

Final assessment

Graded assignment N°1 (weight 20%)

Each of you is asked to look for information about **one of the wireless systems**: Bluetooth, GSM, Wi-Fi.

You will prepare a document (pdf, odt, doc or docx) containing at least the following information:

1. Brief summary of the technology history
2. Bandwidth
3. Examples of emitting/receiving antennae (size, power, conditions of use)
4. Usual values of radiated power
5. Standards & Regulations
6. List of references (list given according to IEEE standard)

The work must be done individually.

You will pay attention to the writing (structure of the sentences, clarity) and to the spelling.

Then you will upload your document in the workshop below and you will be asked to assess the documents of 3 fellow students.

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Before starting the collection of information, discuss together if necessary and [answer the survey](#) below to express which of you will study which technology so that there will be 4 students studying 2 technologies and 5 students studying the third one.

Deadlines:

27/03/2022 to [answer the survey](#) (choose the technology you are going to study)

15/04/2022 to [submit your work \(pdf, ods, doc or docx document\) in the Moodle workshop below](#)

03/05/2022 to [assess the work of your peers according to the criteria specified in the Moodle workshop below](#).

[Survey to define which wireless systems you are going to study: Wi-Fi, Bluetooth, GSM \(deadline 27/03/2022\)](#)

**Result of the
survey :
topic/student**

Bluetooth	GSM	Wi-Fi

[Bluetooth, GSM, Wi-Fi - Graded assignment N°1 \(deadline for submission 25/04/2022, deadline for peer assessment 04/05/2022\)](#)

[Survey about the graded assignment N°1 \(Bluetooth, GSM, Wi-Fi\)](#)

Graded assignment N°2 (weight 75%)

[Graded assignment N°2 about antennae \(deadline 30/05/2022, only one attempt allowed, weight 80%\)](#)

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Appendix 3

Peer to peer activities prepared for master 1 students in Advanced Mechatronics at USMB

MATE701	Materials	Wiki about magnetism and magnetic properties of materials
MCTR702	Metrology	Glossary with comments
PHYS701	Heat transfer	Forum for peer learning forum about heat transfer
PROJ701	Individual project	Workshop about a "virtual" project report
PROJ703	Collective project	Workshop for the final oral presentation
		Moodle/Mahara assignments (pages and feedback)
RECH701	Bibliographical tools	Glossary about bibliographical reference
		Workshop about a fictitious projet
PHYS801	Electromagnetism	Workshop about Wi-Fi, GSM and Bluetooth
PROJ801	Individual project	Workshop for the final oral presentation
PROJ803	Collective project	Workshop for the mid-term oral presentation (in full autonomy)
		Workshop for the final oral presentation
		Moodle/Mahara assignments (pages and feedback)

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Appendix 4

Experience implemented in the course “System level rapid development in mechatronics – E-portfolio assessment table

Formalities & Language	Perfect spelling and grammar	Spelling and grammar are mostly faultless.	Spelling and grammar have minor mistakes.	Spelling and grammar show major mistakes.	Poor spelling and grammar.
	Consistent & correct application of specified citation guidelines. The bibliography contains exactly the literature used in the articles.	Quotations are clearly marked, sources are given in their entirety. The bibliography contains exactly the literature used in the text.	Citations are not always clearly marked, references are sometimes incomplete. The bibliography does not contain all titles and/or titles that are not mentioned in the text.	Citations are insufficiently marked, some sources are missing. The bibliography has no table gaps.	Quotations are not clearly marked, sources are mostly or completely missing (suspicion of plagiarism). The attribution of the literature used is difficult or impossible.
	Precise choice of words, appropriate expression.	Choice of words is precise for the most part, expression is appropriate to the subject matter.	Choice of words is sometimes imprecise, expression is not always appropriate to the subject of the work.	Often inaccurate choice of words, expression is weak overall.	The choice of words and expression are not appropriate to the task.
<i>points scored:</i>	4	3	2	1	0
Structure, Design & Calculations	Overall structure of the work is logical and comprehensible in detail. The artefacts in the e-portfolio are precisely titled.	Overall structure of the work is logical and comprehensible. The artefacts in the e-portfolio are appropriately titled.	Logical overall structure is recognisable, but not always comprehensible in detail. The artefacts are not always comprehensibly titled.	Essential parts of the e-portfolio are available, overall structure has logical deficiencies. The titling of the artefacts is often not comprehensible.	The logic of the structure of the work is not apparent. The titles of the artefacts in the e-portfolio are not comprehensible
	Assumptions in modelling/calculation are fully identified and justified.	Assumptions in the modelling/calculation are identified and justified.	Assumptions in modelling/calculation are partly marked and/or partly justified.	Assumptions in modelling/calculation are weakly labelled and/or justified.	Assumptions in modelling/calculation are not marked and/or justified.

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<i>points scored:</i>	4	3	2	1	0
-----------------------	----------	----------	----------	----------	----------

Content	The topic and objective of the work is precisely described and specified. The topic is placed in a broader context.	The topic and objective of the work are described and specified. The broader context is mentioned.	The topic and objective of the work is described in general terms.	The topic and objective of the work remain vague. No placement in a broader context.	The topic and objective of the work is not described.
	Sources used (e.g. practical examples, literature, empirical data) underline the argumentation and serve to answer the question.	Sources used (e.g. practical examples, literature, empirical data) underline the majority of the argumentation and serve to answer the question.	Reference of the sources included (e.g. practical examples, literature, empirical data) to the argumentation is not evident in some cases, relevance for answering the question remains vague.	The sources used (e.g. practical examples, literature, empirical data) are hardly related to the argumentation; their relevance for answering the question is only hinted at.	Sources included (e.g. practical examples, literature, empirical data) are not related to the argumentation and to answering the question, incorrect sources are included.
	The submitted e-portfolio is complete in terms of content and includes evidence for all 3 milestones, as well as the entry and closing reflections.	The submitted e-portfolio is as complete as possible in terms of content and contains evidence for all 3 milestones.	The submitted e-portfolio is not complete in terms of content; evidence of a milestone is missing.	The submitted e-portfolio is not complete in terms of content; evidence for two milestones is missing.	The submitted e-portfolio is not complete in terms of content; adequate evidence for all milestones is missing

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	The e-portfolio has a logical chain of reasoning, based on the expected level of knowledge. The results are presented and discussed in a complete, detailed and differentiated manner. The work deals with the problem comprehensively (within the scope of possibilities).	Based on the expected level of knowledge, the e-portfolio has a largely logical chain of reasoning. The results are presented explicitly and comprehensibly. The work deals with the objectives.	The portfolio shows in parts erroneous conclusions in the argumentation process. The results are not always presented explicitly and comprehensibly, and there may be gaps with regard to individual aspects.	The argumentation process shows clear errors that can be attributed to many areas of error. The results are not presented in a comprehensible way or hardly relate to the problems.	The argumentation process shows serious errors. The results are not presented or do not relate to the problem. It is obvious that the student has clear knowledge gaps in relation to the lecture.
<i>points scored:</i>	4	3	2	1	0

Reflection & critical examination	The student's own contribution is clearly evident.	The student's own contribution is evident.	The student's own contribution is evident in parts of the work.	Student is largely guided by the performance of others.	No individual contribution on the part of the student.
	The student's own approach and answer to the question are comprehensively reflected upon.	The participants reflect on their own approach and their answers to the questions.	Reflection on one's own approach and answering the question is present in rudimentary form.	Reflection on one's own approach and answering the question is hardly evident.	Reflection on one's own approach and answering the question is missing.
	Alternative solutions are included and critically discussed.	Alternative solutions are included and critically discussed in approaches.	Alternative solutions and perspectives on the topic are included, no or hardly any critical discussion.	Alternative solutions are hardly included, critical reflection is missing.	Alternative solutions are not recognised.
<i>points scored:</i>	4	3	2	1	0

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Collaboration & Cooperation	There is regular and problem-based communication between the group members. (Forum, feedback in the comments).	There is mostly problem-based communication between the group members.	Problem-based communication takes place in parts between the group members.	There is hardly any communication between the group members.	The student does not communicate with his/her own team or with fellow students in general.
	The student communicates appropriately with fellow students and own group members. (written, oral)	The student communicates appropriately with fellow students and own group members as far as possible.	The student does not always communicate appropriately with fellow students and own group members.	The student does not communicate appropriately with fellow students and own group members.	
	The student comprehensively deals with his/her own strengths and weaknesses in relation to the team tasks (reflection on own performance in the team).	The student deals in detail with his/her own strengths and weaknesses in relation to the team tasks.	The student deals with his/her own strengths and weaknesses in relation to the team tasks.	The student hardly deals with his/her own strengths and weaknesses in relation to the team tasks.	The student is not able to reflect on his/her own strengths and weaknesses in relation to the team tasks.
<i>points scored:</i>	4	3	2	1	0

Feedback	The student deals productively with feedback from the lecturer/staff/fellow students. He/she demonstrates differentiated engagement with	The student engages with feedback from the lecturer/staff/fellow students and demonstrates comprehensible engagement with feedback in the e-	The student engages with feedback from the lecturer/staff/fellow students in parts. Evidence of engagement with feedback in the e-portfolio or comments section is incomplete.	The student hardly engages with feedback from the lecturer/staff/fellow students. Evidence of engagement with feedback in the e-	The student does not demonstrate engagement with feedback from the lecturer/staff/fellow students.
-----------------	--	--	--	--	--

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	feedback in the e-portfolio or comments section.	portfolio or comments section.		portfolio or comments section is marginal.	
	The student is able to formulate constructive feedback on the work of fellow students. In doing so, he/she refers to the guidelines and expectations of the lecture. 2	The student is able to formulate helpful feedback on the work of fellow students. He/she refers to the requirements and expectations of the lecture.	The student is partially able to formulate constructive feedback on fellow students' work. Specifications and expectations of the lecture are slightly included.	The student finds it difficult to formulate constructive feedback on fellow students' work. Specifications and expectations of the lecture are hardly included.	The student is unable to formulate constructive feedback on fellow students' work.
<i>points scored:</i>	4	3	2	1	0
<i>Total score:</i>					
Commentary:	Individual learning growth as a bonus in assessment. Goal: Demonstration of an engineering approach to work				

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*Appendix 5*

Example of documentation written by 3 students about logistic systems
and the impact of the Covid-19 global crisis (excerpt)

MINISTERUL EDUCAȚIEI ȘI CERCETĂRII



UNIVERSITATEA TEHNICĂ
DIN CLUJ-NAPOCA

Cuprins

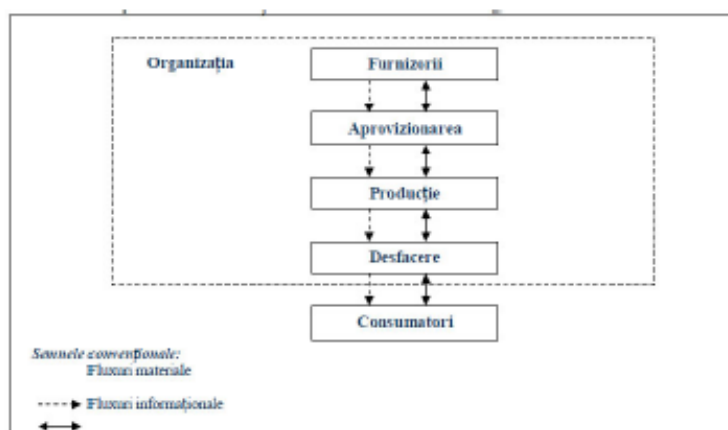
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Stadiu actual.....	4
Descrierea problemelor.....	6
Criza sanitara Sars COV2	6
Efecetele crizei sanitare.....	6
Deficiențele lanțului de aprovizionare evidentiate de COVID 19.....	7
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Introducere

Sistemul logistic reprezintă noțiunea de bază ale logisticii și asigură funcționarea mecanismului economic al unei companii sau țări. Acesta îndeplinește anumite funcții, conține câteva subsisteme și dezvoltă relațiile cu mediul extern.

Sistemele logistice se deosebesc între ele prin structură, volumul de activitate al întreprinderii, strategia de dezvoltare și alte caracteristici.



Scopul principal al sistemului logistic este asigurarea livrării marfurilor în cantitatea, calitatea și sortimentul specific companiei cu costuri logistice pentru achiziționarea, desfacerea sau ieșirea fluxului de material, planificarea producției cât mai mici.

Proprietățile sistemului logistic sunt:

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B-dul Muncii nr.103-105, 400641 Cluj-Napoca, România
tel. +40-264-401603, 401787, tel./fax +40-264-415490, <http://www.armm.utcluj.ro>



Relatiile contractuale in perioada Covid 19

In urma declararii pandemiei de Sars-COV-2 de catre Organizatia Mondiala a Sanatatii, statele au luat masuri de preventie si combatere a extinderii virusului, iar impactul acestor masuri se resimte deja la nivel intern si international, la nivelul fluxurilor de capital, turismului și migrației.

Toate masurile luate de statele lumii se reflecta si asupra contractelor incheiate, indiferent ca sunt guvernate de dreptul national sau international. In contextul masurilor luate la nivel mondial de catre state, s-a ridicat problema modului in care pot fi invocate cauzele de forta majora, care exonereaza partile contractuale de raspunderea civila in urma neindeplinirii obligatiilor, aceasta survenind in urma restrictiilor impuse de guvern, lipsa angajator determinata de izolare sau carantina.

Articolul 1.351 alin. (2) Cod Civil definește forța majoră ca fiind orice eveniment extern, imprevizibil, absolut invincibil și inevitabil.

Scopul reglementării instituției forței majore în majoritatea sistemelor de drept constă în posibilitatea de a exonera debitorul de răspunderea derivată din neexecutarea totală sau parțială a obligațiilor contractuale asumate, ca urmare a intervenirii unor motive exterioare și neimputabile acestuia.

În măsura în care imposibilitatea de executare este absolută, debitorul este eliberat de obligație, iar în cazul în care imposibilitatea de executare este temporară, debitorul beneficiază de o suspendare a obligației, pentru o durată de timp rezonabilă.

In sistemul de drept din Romania, cazul de forta majora opereaza in temeiul legii fara a fi nevoie sa fie cuprinsa in contract, daca partile nu au convenit altfel. Daca partile au cuprins in contract valorificarea cauzei de neraspundere, atunci debitorul trebuie sa respecte conditiile contractuale.

They have also analysed the impact of the Covid-19 on the economic aspect.