



Competency Portfolio Assessment guidelines

Marina Zingraf, Albert Meij, Christine Galez, Laurent Tabourot, Virginie Siret, Alexandru Ianosi, Dan Stan

► To cite this version:

Marina Zingraf, Albert Meij, Christine Galez, Laurent Tabourot, Virginie Siret, et al.. Competency Portfolio Assessment guidelines. [0] Intellectual Output 5, Hochschule Kaiserslautern - University of Applied Sciences; Université Savoie Mont Blanc; Technical University of Cluj-Napoca. 2021. hal-03788247

HAL Id: hal-03788247

<https://hal.science/hal-03788247>

Submitted on 7 Oct 2022

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CROSSING BORDERS: PEER-TO-PEER EDUCATION IN MECHATRONICS

Project Reference	2019-1-FR01-KA203-062208
Intellectual Output	O5 - Competency Portfolio Assessment guidelines
Date of Delivery	9 th April 2021
Main author	Marina Zingraf (HSKL)
Participants	Albert Meij (HSKL) Christine Galez, Laurent Tabourot, Virginie Siret (USMB) Alexandru Ianoși, Dan Stan (TUCN)

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1. Introduction

The project participants of the XP2P project have set themselves the goal of integrating new teaching and learning methods into engineering. Using the example of mechatronics, the influence of peer-to-peer learning in connection with an e-portfolio on the acquisition of competencies by students will be investigated. The project results from the conviction that peer learning, i.e. learning with and from each other, is one of the most important forms of learning to strengthen informal learning and to promote self-learning competence. Since the peer-to-peer learning process requires that teaching staff remain in the background, it is necessary to monitor the process and provide only guidance and support. For this reason, an instrument - the e-portfolio - was chosen to document the learning process of the students, to enable them to critically examine their own learning process and to give the teachers the option to intervene where help is needed.

The idea of portfolio valuation is not new, but it is not yet widely used in the engineering sector. The introduction of such an element into the curriculum has the advantageous potential to extend it to other modules (courses, projects...) as well. Once the e-portfolio is structured for the specific reporting needs in engineering and implemented in the respective Learning Management Systems, the transferability to other modules/courses/projects is very favourable. The aim of this paper is therefore to develop a framework for the structure and the contents to be documented in the competence portfolio. This framework is to be applied, checked and, if necessary, optimised in the course of the project. In this way, the application of e-portfolios can be favoured and simplified in other engineering fields in the future.

Finally, the structure of this paper should be explained: in the following chapter, based on the current state of research on portfolios in higher education, a basic definition of e-portfolios will be formulated, which combines both the demands of higher education and the objectives of the XP2P project. This will be followed by an examination of the didactic requirements for e-portfolios - starting with general scientific knowledge concerning digital collections and then moving on to an examination of specific elements of e-portfolios in engineering.

Based on the didactic findings from the literature work, the necessary results for the XP2P project are then presented - the e-portfolios, the didactic concept including the required contents of the e-portfolio and a general competence framework.

2. (E-)Portfolios in higher education

In order to get an understanding of why e-portfolios are used in higher education, it is necessary to first deal with the definition of such an e-portfolio. A basic definition of the portfolio can be found in Paulson, Paulson and Meyer. They state the following:

"A portfolio is a purposeful collection of student work that exhibits the student's efforts, progress, and achievements in one or more areas. The collection must include student participation in selecting contents, the criteria for selection, the criteria for judging merit, and evidence of student self-reflection." (Paulson, Paulson & Meyer, 1991, p. 60)

The authors bring together the essential aspects of a multitude of definitions. Therefore, some of the elements of the statement will be examined in the following. First of all, however, it should be mentioned that the definition of Paulson, Paulson and Meyer concerns portfolios in general, i.e. especially collections of artifacts that are compiled in a map, whereas e-portfolios include electronic media that are collected on websites or on CDs/ DVDs (Peacock et al., 2010, p. 828/ Lorenzo & Ittelson, 2005, p. 1). For this reason, the definition of the authors will be expanded to include specific aspects of digital portfolios and adapted for the XP2P project.

Paulson, Paulson and Meyer describe the portfolio as a "purposeful collection". There are different perspectives on what purpose such a collection serves. Lorenzo and Ittelson present three different types of e-portfolios - student e-portfolios, teaching e-portfolios and institutional e-portfolios (Lorenzo & Ittelson, 2005, p. 3-7). The two authors conclude that the potential of an e-portfolio is in the optimisation of "teaching, learning, and assessment practices" (Lorenzo & Ittelson, 2005, p. 1). This means that the purpose varies depending on the creator of the portfolio. For example, the purpose for the students is to optimise their approach to learning, while institutions such as universities aim to achieve a more authentic assessment of their students. A portfolio can also be characterized by the intention of presentation, which is specifically designed for a particular audience and is associated with a "particular rhetorical purpose" (Roberts, Maor & Herrington, 2016, p. 23).

Other aspects are also found in Barrett and Carney. They distinguish between three categories in regards to the purpose of a portfolio:

1. Product-oriented portfolios represent services designed to demonstrate externally prescribed skills and competencies (Barrett & Carney, 2005, p. 2). This is therefore a summative assessment, in which the result is evaluated, similar to an exam.
2. Process-oriented portfolios, on the other hand, document the learning process of the students and invite them to reflect on their own abilities and learning processes (Barrett & Carney, 2005, p. 2). Such a portfolio then aims at a formative assessment, since the learning progress is constantly monitored and intermediate results can be used to adjust the course planning.
3. In addition, the authors name a third purpose of a portfolio, which includes aspects of both categories and cannot be assigned to one of the two categories in general. They call this purpose "marketing". This refers to portfolios that are presented to a potential employer. The creators of such portfolios present their best work, which they consider to be particularly interesting and meaningful for the application process. These portfolios can be evidence of certain skills and competencies, but can also include selected reflections (Barrett & Carney, 2005, p. 2-3). However, since a conscious selection of suitable artefacts takes place here, such collections contain aspects of both product- and process-orientation.

Chau and Cheng combine these statements and thus arrive at the following intentions of the digital collections: For the students, the purpose in creating the portfolio is to further develop individual learning, to present it and to reflect on it. The teachers' intention is to evaluate students more individually, thus rewarding the complexity of their learning behaviour. Finally, the purpose is to give graduates the opportunity to present and demonstrate their competencies to a potential employer (Chau & Cheng, 2010, p. 933).

Further, Paulson, Paulson and Meyer add in their previously mentioned definition that a portfolio reflects the "student's efforts, progress, and achievements".

This powerful tool allows students to carry out reflective learning, i.e. to regularly review their learning and the acquisition of new skills, to explain this process and to prove it (Ravet, 2005, p. 19-20) by linking it to documents such as pdf, videos, photos, website, comments from peers, colleagues, teachers or tutors etc... This e-portfolio can be evaluated as such, beyond the different activities that will be requested.

The e-portfolio is also a technical device allowing to:

- Make progress in learning (for example by keeping a logbook of learning)
- Validate one's skills (for example the validation of acquired experience)
- Validate one's skills or experience (for example to find a job)
- Reflect on career or life (for example to make a skill assessment)

The term e-portfolio is therefore used both to describe the process (collect, connect, select, reflect) and the resulting document.

Indeed, in a more modern definition of e-portfolios, Chau and Cheng speak of "digital evidence", which are assembled from a variety of media types collected over a specific time period (Chau & Cheng, 2010, p. 932). A more detailed explanation describes that these digital artefacts have a personal relevance for the portfolio creator and represent a broad range of learning experiences that are linked and expanded with different data sources (Peacock et al., 2010, p. 828). The digital artefacts can have both formal and informal learning character (Peacock et al., 2010, p. 828) and include text-based and multimedia elements as well as graphics (Lorenzo & Ittelson, 2005, p. 1). Digital artefacts that represent a formal learning character include all those contents that relate to the pure acquisition of knowledge, whereas informal learning contents refer to the self-directed learning processes of students. Such learning processes are based on the realities of the individual's life and are designed to develop skills. In contrast to knowledge acquisition, the results can vary. One example of these informal artefacts are reflections. They are a specific type of artefacts, which are given special consideration in the literature on e-portfolios and are incorporated into every modern definition of portfolios. Reflections serve as a tool for students to view and question their own learning (Peacock et al., 2010, p. 828).

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The results of such reflections are then very diverse, as they are shaped by different approaches of the students and influenced by different levels of prior knowledge, everyday experiences and personal goals. If the portfolio is made available to a (self-selected) audience, the personal reflections in particular invite the exchange of ideas, assistance and (peer-) feedback (Lorenzo & Ittelson, 2005, p. 1).

An important aspect of the digital portfolio that is not included in the general definition of Paulson, Paulson and Meyer is the access to the e-portfolio. The creator of the portfolio acts as its owner, (s)he alone decides who gains access to the portfolio and to what extent (time limit, access only to certain artefacts in the portfolio). The students' motivation to present the portfolio to others is to get (peer-) feedback and thus to gain a better understanding of the topic dealt within the portfolio and to achieve personal growth (Duncan-Pitt & Sutherland, 2006, p. 70/ Peacock et al., 2010, p. 828). The intrinsic motivation of the individual is therefore of central interest.

For the purpose of the XP2P project, the following definition was determined: The e-portfolio is a digital collection created to assess learning progress and includes multimedia evidence of students' efforts and competences. A special role in this collection is taken by reflections that support a critical examination of individual learning behaviour and promote exchange with the viewers of the portfolio. The creator of the e-portfolio is its owner, who shares content in order to improve her/his learning, thus the intrinsic motivation of the student is emphasized. This definition will therefore serve as a basis for the following chapters.

From the purpose and content of the e-portfolio, it is thus possible to conclude the particular advantages of the e-portfolio for the higher education sector. Chau and Cheng write the following about learning:

"[...] students construct new knowledge based upon their prior experience and personal interpretation of the world rather than passive reception of information" (Chau & Cheng, 2010, p. 932)

The e-portfolio not only checks the extent to which knowledge has been absorbed, but also looks at how this knowledge is handled. Students are given the opportunity to deal intensively

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with their own learning and to apply what they have learned in an individual way. By working on reflections, students learn to assess and manage their own learning. This can be a special motivation to participate actively in the development of the e-portfolio (Roberts, Maor & Herrington, 2016, p. 24). Chau and Cheng summarise important aspects associated with this under the terms "personalised learning" and "learner responsibility". "Personalized learning" describes a strengthening of the students' commitment and motivation to explore topics from a personal perspective (Chau & Cheng, 2010, p. 933). "Learner responsibility" on the other hand is the conclusion that an independent learner accepts responsibility for her/his learning. This means that (s)he sees a personal benefit in learning the necessary contents. This promotes a positive attitude towards learning itself and develops the ability to reflect consciously on content (Chau & Cheng, 2010, p. 933). Together with the integration of feedback, peer review and discussions on e-portfolio platforms, digital collections have the potential to positively influence lifelong learning processes through constant exchange and editing of contents (Bhattacharya & Hartnett, 2007, p. 19/ Deneen, 2013, p. 2). E-portfolios support students in taking responsibility for their own learning by exploring study contents from a personal perspective and discussing them with fellow students in (online) discourses. Students can thereby gain a higher degree of independence and self-confidence and are prepared in a promising way for lifelong learning processes. In addition, the digital collections are an instrument to connect to the students' life reality. Reese and Levy argue that current students are familiar with communicating and sharing their experiences online using digital media. E-portfolios are then a way of combining these aspects in an academic context: students can set their own goals and document and share their work on the Internet while at the same time reflecting on their own learning (Reese & Levy, 2009, p. 3/ Chau & Cheng, 2010, p. 936/ 937).

The e-portfolio is also described as an authentic form of assessment, as it makes the students' self-defined goals, critical thinking, approaches to solving complex problems and reflections on the individual learning process visible (Bhattacharya & Hartnett, 2007, p. 19/ Reese & Levy, 2009, p. 3). This gives teachers the advantage of recognising the weaknesses and problems of students and providing individual support (Gomes, 2008, p. 15).

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This explains why e-portfolios can be of particular interest in the university sector. The aim of a portfolio is not just to acquire knowledge; it is instead designed to help students acquire competencies - competencies that combine both hard and soft skills, which are on the one hand specified by the teachers but are also influenced by the students in their focus on the other hand. With regard to the e-portfolios, the institution of higher education acts as a companion through its representatives, the lecturers, who offer support, provide their own experience and set impulses, but do not restrict individual learning. Different life situations of adult students are taken into account in a special way in the e-portfolio: Digital working offers them the opportunity to flexibly select their working hours, places of work and equipment (laptop, mobile phones, etc.), to network with their fellow students and teachers according to their needs and to acquire competences and knowledge based on their personal life experiences and interpretation. Students are granted the ability to take responsibility for their own learning and individual approaches are rewarded so that self-esteem can be strengthened.

In view of the current situation, the following should be added in conclusion. Even if the portfolio as a tool is not a new discovery, it can be a solution to current problems that the pandemic has created for higher education: The e-portfolio offers incentives for students to work continuously on lecture content throughout the semester without losing flexibility. Artefacts can be created according to one's own capabilities without the risk of disadvantaging individual students due to poor Internet connections or outdated work equipment. Feedback possibilities on e-portfolio platforms allow for constant communication between teachers and students or students and students. Since communication is asynchronous, teachers and students can freely arrange their working hours on the portfolio, but teachers still have the possibility to intervene directly if they notice that individual students do not understand certain contents and can provide individual assistance. The e-portfolio then results in a multi-dimensional examination performance that can be submitted by students without having to be present at the educational institution.

3. Didactic approach on e-portfolios

3.1. Didactic requirements for an (e)-portfolio

Behind the term "Ermöglichungsdidaktik" (engl. empowerment didactics) lies the conviction that adults learn most successfully when they can control their learning processes themselves and shape them according to their subjective realities (Schüßler & Kilian, 2017, p. 83). The aim is not to absorb knowledge objectively, but to apply this knowledge individually and to develop related competencies (Schüßler & Kilian, 2017, p. 89). The aim of this didactics is to make the teachers understand that teaching is not able to convey knowledge to all learners equally. Instead, learning processes take place in an individual way when learners apply knowledge (Arnold, 2012, p. 46). In university education, there is also an increasing shift towards a system in which the learners work on the contents themselves and are supported and encouraged by the teachers in their learning process, i.e. they take on the role of learning companions (Schüßler & Kilian, 2017, p. 85). Students must not only acquire knowledge, but also apply this knowledge in order to work on complex tasks - there is a shift towards competence orientation (Quellmelz & Ruschin, 2013, p. 19).

But what does competence orientation mean in an academic context? The concept of competence has already been mentioned several times in the previous chapter without specifying it in more detail for university teaching. Schaper defines "academic competence" as the ability to deal constructively with complex, novel and challenging tasks (Schaper et al., 2012, p. 29). In the academic context, these skills include the following elements: scientific concepts, analysis, reflection, innovative concepts and problem-solving skills, communication of scientific knowledge (Schaper et al., 2012, p. 29), and

"Self-regulation and reflection of one's own problem-solving and knowledge-driven actions"
(Schaper et al., 2012, S. 29)

This chapter is supposed to show that the e-portfolio can be understood as a practical implementation in the sense of "Ermöglichungsdidaktik" (engl. empowerment didactics), in which the didactic understanding of competencies in the academic context is realised.

In this context, the didactic understanding of "student engagement" is also incorporated into the process of portfolio creation. Here it is described that learning processes become better the more students deal with a topic. The quality of this engagement is determined by the amount of time students spend on a topic, the topic-specific engagement with others (fellow students/teachers/employees) and the use of further learning resources (Mayrberger, 2017, p.113). The e-portfolio, whose main features are the continuous work on it, the exchange with fellow students and teachers and the use of multimedia learning resources, aims at this very "student engagement".

The following paragraphs deal with the didactic aspects of the design of such an e-portfolio and the demands it places on students and teachers. The structure of the chapter depends on the sequence of the portfolio work and can be used as a progress plan for the portfolio conception.

Before using the portfolio, it is first of all important to define basic aspects of portfolio work. As basic building blocks, the learning objectives and the purpose of the use of the e-portfolio must first be defined. It is also recommended to define evaluation criteria, tasks and a basic structure (Stratmann, Preussler & Kerres, 2009, p. 97). These points should be determined in advance by the teachers and staff. However, since the e-portfolio is a work and learning element that is unknown to most students, it is important to create as much transparency as possible. This means that learning goals and results that can be achieved through the portfolio tasks, as well as criteria that are included in the assessment, should be agreed with the students at the beginning (Kilian-Yasin & Müller, 2012, p. 113/ Chan & Yan, 2013, p. 92). It is necessary to define a focus at the beginning, which will be supplemented by additional tasks in the course of the semester (Bräuer, 2004, p. 24). Tasks associated with the portfolio should neither be too prescriptive nor too openly formulated. The former does not challenge the students enough and limits creative approaches to solutions, as it severely restricts the approach. Too open formulation, on the other hand, is perceived as a deterrent due to its lack of clarity (Hao Yang & Wu, 2013, p. 168). Therefore, a middle way must be created in which students are given as much self-control as possible (Quellmelz & Ruschin, 2013, p. 20) without overburdening them with too much freedom. The acceptance of portfolio work can be

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increased if the tasks are formulated according to the students' realities. It is therefore advisable to involve student assistants in the conception of the tasks and thus to use a language style that is familiar to the students (Kilian-Yasin & Müller, 2012, p. 113).

It is also helpful if the professor/teacher/lecturer creates an example portfolio. This will make the use of the portfolio authentic (Strasser & Knecht, 2012, p. 42) and the students will get a better impression of what a collection can look like or what kind of idea is pursued with it in the course of the lecture unit.

For the students the portfolio work starts with the collection of artefacts. Those artefacts can be products such as videos, podcasts or photos, as well as executions that arise in the learning process, such as reflections (Stratmann, Preussler & Kerres, 2009, p. 97/ 98). The e-portfolio serves as a digital repository in which artefacts are collected in a structured manner (Hampshire & O'Connor, 2012, p. 9); this structure, however, is not predetermined from the outside, but is determined by the creators themselves. Therefore, the portfolio can be understood as a creative process that reflects personal approaches of the creator and proves his or her ability to present the artefacts systematically and authentically (Panyukova, 2019, p. 4).

An important didactic tool of the e-portfolio is the use of reflections. The personal character of the e-portfolio and a comprehensible connection between the accumulated artefacts can be made visible in the reflections (Jarvin & Kohonen, 1995, p. 34). In general, the reflection artefacts can be described as "reflective self-assessment" (Jarvin & Kohonen, 1995, p. 29), which means that a critical examination of one's own learning takes place. The focus is shifting from a teacher-centred format, which imparts knowledge in order to finally question it in an examination, to a format that reflects the students and their learning processes. A kind of paradigm shift is taking place in which students are no longer concerned with "satisfying" the teacher but with improving the quality of their own learning (Lawson & Thompson, 2012, p. 150). This enables the exit from the role of passive knowledge recipients (Strasser & Knecht, 2012, p. 38). Instead, students must actively deal with information, question them and internalize them in connection with their individual prior knowledge, different everyday experiences and personal goals.

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“Self-assessment is a process of formative assessment during which students reflect on and evaluate the quality of their work and their learning, judge the degree to which they reflect explicitly stated goals or criteria, identify strengths and weaknesses in their work, and revise accordingly” (Lawson & Thompson, 2012, p. 149)

As mentioned in the previous chapter 2, the portfolio aims at a formative assessment. Such an assessment is linked to a continuous review of individual learning progress and the adjustment of course planning based on intermediate results. Reflection is particularly suitable for such a review, as it requires students to honestly discuss their learning progress, to place what they have learned in an overall context and to view it critically. The students have to question to what extent they are approaching their self-imposed learning goals and what difficulties might prevent them from achieving these goals. It can be helpful to give the students specific questions to which they can write their reflections. By asking the same questions to all students, it is then easier for them to exchange information and give each other constructive feedback (Strasser & Knecht, 2012, p. 45). Merminod relates three learning objectives to the reflection units - identifying competences, formulating them and communicating them (Merminod, 2012, p. 231). In the first step, the reflections should encourage students not to set their learning goals in relation to knowledge acquisition, but to consider which competences they would like to acquire in the lecture/seminar/ project (Merminod, 2012, p. 231). In the second step, the students formulate and explain these competences for themselves in their reflections (Merminod, 2012, p. 231), so that they make it understandable for themselves what goes along with these competences and how they can achieve them. In the last step, students communicate the competences to the outside world and present them to an audience (Merminod, 2012, p. 231/ 232). This means that they must provide a link between the multimedia artefacts and the reflection contributions in order to present the extent to which the self-imposed goals and competences have been achieved.

To monitor peer learning in particular in the framework of the XP2P project, but also the acquisition of skills by students as they progress through the system, teachers will act as coaches and facilitators. The creation and input of e-portfolios will enable teachers to follow the work and progress of students in their courses and projects.

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Since the aim of the e-portfolio is to track the increase in students' competencies over the semester, it is useful to check the level of knowledge and existing competencies at the beginning and end of the seminar/lecture/project. This can be done by means of questionnaires (Quellmelz & Ruschin, 2013, p. 20) or the special feature of the e-portfolio - the reflection artefacts - can be used. For this purpose, initial and final reflections can be introduced. The introductory reflection should then link knowledge and skills already acquired in previous lectures, projects and seminars on related topics. It can show which aspects have so far been neglected in one's own learning, which goals are set for the following semester, where the individual strengths and weaknesses in the respective topic can be found. Assistance can be given by pre-fabricated forms which contain open questions which the students can answer. For example, the following questions can be used for an introductory reflection independent of the topics of a lecture/seminar/project:

- Which focus do I choose for my portfolio? Why?
- What knowledge do I already have on the subject?
- How do I want to approach the portfolio strategically?
- At which points do I possibly need assistance?

A final reflection should then evaluate the own learning process, take up the most important findings of the lecture/seminar/project, formulate still open questions and give an outlook on the further learning process. The following questions can serve as guidelines for the final reflection:

- What benefits do I generate through the portfolio for myself and for others?
- In what other context can the portfolio be helpful (e.g. work/ other lectures/seminars/projects)?
- What strengths and weaknesses have I identified in myself?
- Which topics were not sufficiently considered in the lecture/seminar/project and/or in the portfolio?

Artefacts should be compiled in the e-portfolio in a logical way so that they can be presented and distributed. It is therefore necessary that the audience can recognise a structure in the digital collection. A common thread in the presentation can be represented purely visually, or

by numbered headings of the artefacts that are based on each other. In addition, the creators of the e-portfolio have the possibility to justify correlations in the reflection artefacts and/or use text/video/sound artefacts to explain their own structures.

In higher education, it is mostly the teachers and fellow students who can view and comment on the digital collections (Stratmann, Preussler & Kerres, 2009, p. 98). However, the creators of the portfolio can decide which audience they want to make their portfolio available to; this necessitates targeting the presentation of the e-portfolio to their audience and to question to what extent the presentation is understandable for the viewers. A non-specialist audience, for example, will find it more difficult to understand visual connections, so additional explanatory elements may be helpful. However, since the portfolio in this paper is intended to serve as a basis for evaluation in courses, it is important to talk to the students beforehand about why they should open their collections for other students and the teacher(s) and why they should make them comprehensible. This reasoning is based on the feedback and the benefit that the students derive from it:

“[...] it is high quality feedback that makes the difference between an assessment of learning and an assessment for learning” (Sporer, Sippel & Meyer, 2009, p. 10)

Feedback is a central element in portfolio work and is only helpful if those who evaluate an e-portfolio also understand its structure. Feedback is optimally useful when it is individually adapted to the creator of the portfolio. In particular, the acquisition of competencies should be the focus of the teacher's assessment (Sporer, Sippel & Meyer, 2009, p. 11). Due to the time required for such an assessment, it is helpful for the teacher to share the responsibility for feedback and to delegate the task to the students. For this reason, a total of three types of feedback can be implemented within the e-portfolio and used for the final overall evaluation. This includes feedback from the creator of the portfolio - as explained in detail above, the creator evaluates her/himself and her/his learning process in reflection sessions. In addition, peer feedback and feedback from an authority, i.e. the lecturer/teacher/seminar leader, are also included (Sporer, Sippel & Meyer, 2009, p. 10). In the context of feedback through fellow students, it is important to create an external motivation for students to evaluate each other, because it is an additional workload on the one hand, and on the other

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hand it can be an overcoming to express criticism of the work of others. There are three ways to create a productive peer feedback in relation to the portfolio. One possibility would be to establish learning tandems (Sporer, Sippel & Meyer, 2009, p. 12) in which students with different levels of knowledge help each other. This would have the consequence that the same constellations of people continuously evaluate each other throughout the course of the e-portfolio. Another approach would be to promote the intrinsic motivation of students by emphasising the benefits of such mutual assessments. As soon as the students deal with each other's portfolios, with their creative and personal approaches to the implementation of the given assessment criteria and the achievement of the competences, they also learn to understand the assessment criteria better and to identify their own difficulties (Sporer, Sippel & Meyer, 2009, p. 12). This requires a high degree of persuasiveness on the part of the teacher. Since such motivation is based on voluntariness, it can happen that even motivated students neglect feedback in favour of time-consuming commitments in other seminars, projects and lectures. The third possibility is to make a certain number of peer-feedback units mandatory for the students and thus include constructive evaluation as a competence goal. There is, however, the danger that students do not write these assessments continuously throughout the semester, but rather "work through" them at a time that is convenient for them. **Due to the peer-to-peer approach in the XP2P project, it makes sense to combine the three approaches: small groups would then work together continuously throughout the semester in the spirit of learning tandems, provide mutual support and optimize cooperation through constructive feedback. Beyond the small groups, students would then be required to write a certain number of assessments for their fellow students. In this way, the teachers would make the advantages of active feedback understandable and the students would be motivated to constantly deal with the portfolios of the others, even beyond the obligatory assessment units.**

Finally, students should be required to demonstrate that they have dealt with feedback from the lecturer and fellow students on their own portfolio. In this way, a feedback culture can be implemented during the semester. Proof is not necessarily provided by obediently accepting the feedback, but a conclusive justification for not accepting it can be provided instead. The prerequisite for this is a demonstration of how the criticism has been dealt with

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and a comprehensible justification for a different approach than that suggested by the lecturer or fellow students. In this way, the personality development of the students can be promoted, since the feeling of being subordinate to the lecturer is not conveyed, but the impression of being entitled to make own decisions is strengthened. This also promotes the self-confidence of the students.

With the e-portfolio, as with any scientific work, it is important not to neglect respect for intellectual property. This means that citations and references should also be included in the artefacts. Likewise, a bibliography can be added at the end of a digital collection, provided that third party intellectual property has been used.

Finally, an e-portfolio can also be assessed summatively in a similar way to an exam (Stratmann, Preussler & Kerres, 2009, p. 98). However, due to the subjective nature of e-portfolios, where artefacts such as reflections in particular cannot be classified in categories such as right and wrong, it is necessary to make clear evaluation criteria transparent for students (Sporer, Sippel & Meyer, 2009, p. 10). Independent of the subject-related evaluation criteria, the following aspects can be evaluated in an e-portfolio: Appropriate scope, completeness, comprehensible and systematic structure, sound and factual accuracy, content and coherence (common thread, individual parts form a whole), originality, authentic and constructive reflection sections, formal criteria (artefacts have appropriate titles and references, bibliography, uniform font and font size, chosen layout etc.), linguistic formulations (grammar, spelling), sworn statement.

Within the XP2P project, alternative examination methods were also considered - these include exams, open-book exams, multiple choice tests, homework, 24-hour assignments, essays, oral exams, colloquia, (group) presentations, project work, experimental games and (digital) simulations. The following should be noted: The success of a lecture/seminar/project is primarily related to the purposes and goals associated with it. In the case of the XP2P project, two concepts, peer-to-peer learning and e-portfolios, are to be combined. Both concepts aim at self-directed learning, which offers students the possibility to set their own learning and competence goals according to their own life realities and to develop them further in cooperation with fellow students. Therefore, a purpose of the E-portfolio is to

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provide an optimal tool for the peer-to-peer concept, on the basis of which students' performances can be assessed. Two aspects of the e-portfolio are thereby of particular importance - reflection and feedback. These are the most important links to cooperative learning, as they offer the greatest potential for exchange within the group and with the teacher. In addition to the assessment function, the e-portfolio aims at improving the career development of students, as they not only work towards a degree, but also learn to identify and elaborate necessary competences. It has also been mentioned in a previous chapter of this paper that the current pandemic poses new challenges for educational institutions. Especially the low predictability about the further development of Covid-19 endangers the normal operation of universities and makes hybrid learning formats necessary. An e-portfolio thus also provides teachers with planning security, as it is created asynchronously and independently of the learning location, while still providing a holistic picture of the learners throughout the semester.

The academic concept of competence cited at the beginning was defined as the ability to constructively deal with complex, novel and demanding areas of responsibility. Indeed, for Jacques Tardif, a competency is defined as "a complex know-how to act based on the effective mobilization and combination of a variety of internal and external resources within a family of situations" (Tardif, 2006, p. 26-35).

It was stated that this concept of competence includes the application of scientific concepts, analyses, reflections, problem-solving skills, scientific communication and innovative concepts. It was precisely these elements that are identified as components of the e-portfolio. Thus, students have to work on scientific concepts and complex problems in the portfolio, analyse them and reflect on them from a personal point of view. They have to design the e-portfolio according to a target group and communicate their scientific results appropriately. In the sense of "Ermöglichungsdidaktik" (engl. empowerment didactics), these components are developed within the realities of students' lives in individual learning processes.

The document itself is built up during a process in which the student must:

- Collect the results of her/his learning, the tangible traces of her/his skills, gather direct and indirect evidence, the results of her/his work, accounts, etc. It is the construction of an archive of artefacts created during her/his learning.
- Select the most significant tangible evidence of her/his learning to present to others. It is a work of editing and choosing evidence from which to begin a process of reflection to link the different learning experiences.
- Integrate new learning with what has already been learned. It is a work of integration that makes it possible to give meaning to what has just been learned in relation to previous learning, to link facts and ideas developed in different contexts.
- Reflecting on one's learning (reflexive learning), giving meaning to one's learning by answering questions: what have I learned, how will it change my way of learning or working etc.

For a student, the e-portfolio can be the means to:

- Manage their lifelong learning, enhance their competences, prepare for working life and continuing professional development
- Mastering one's "digital identity"

3.2. Transition to portfolios in engineering and their specific characteristics

While the previous chapter aimed to provide general recommendations for the creation of an e-portfolio, the more recent literature also contains suggestions for specific characteristics for portfolios in engineering. As these are mostly recommendations from comparatively smaller research units and individual special areas of engineering, they are only taken up in this sub-chapter and can be seen as possibilities to optimise the e-portfolio for engineering degree programmes.

Lima and Christy point out that engineers are increasingly expected to have good communication skills and an understanding of the work environment in addition to their technical skills. By working on an e-portfolio and taking responsibility for their own learning processes, students could not only better understand scientific concepts, but also gain a better understanding of their future role as engineers and thus establish a link between higher education and their aspired careers (Christy & Lima, 1998, p. 1/ 2). To make a meaningful link between e-portfolios and learners' future careers, the authors have taken different approaches. Advanced students were asked to choose a company and were given the task of tailoring their portfolios specifically to the company and, by being in constant contact with the company, adapting their own collection as they were created (Christy & Lima, 1998, p. 3). Students who were at an earlier point in their education should prepare for their career goals by doing Internet research. The e-portfolio was then used to present projects that they wanted to work on, to research trends in the field, to make links between the projects they wanted to work on and current trends, and to reflect on whether the career path they wanted to pursue made sense for them (Christy & Lima, 1998, p. 4). The authors thus used the e-portfolio as a means of addressing career goals. This gave the students the opportunity to deal with an area that is important to them and to develop competences in a targeted manner. The learning objectives of the portfolio were not abstract for the students, but had a personal meaning and were linked to an intrinsic motivation.

Williams has a different focus in her paper - for the author, the lack of (written) communication skills is a difficulty in the training of engineers. In her view, it has historically been shown that the industry expects engineers to be able to communicate their work effectively to customers and employees (Williams, 2002, p. 202). However, due to time pressure, standardized tests do not provide an authentic picture of students' writing skills, but instead it is more useful to collect meaningful text examples over a longer period and thereby assess an overall picture (Williams, 2002, p. 201). In this way, the educational institutions would then also have the opportunity to enforce uniform communication in engineering and to convey this to the students. This is not so much a matter of uniform grammatical standards, punctuation etc., but rather of an "analytical, rhetorical perspective" (Williams, 2002, p. 202), which combines critical thinking and analysis of the target groups with whom communication is taking place (Williams, 2002, p. 202). The author suggests three components that can be used to strengthen communication - exchange of feedback, analysis of documents and proximity to the audience (Williams, 2002, p. 202). This means that students should work with existing documents that are understood by teachers as good representations of scientific communication. For this purpose, students should write their own drafts and reflections that connect them with a target group and demonstrate the criteria according to which the papers were written for this target group. Finally, students should receive feedback for their discussions, but teachers should also be open to feedback from students when it comes to the design of the e-portfolio or aspects of good scientific communication (Williams, 2002, pp. 202-205).

The author Nikos J. Mourtos, on the other hand, defines five competencies that should be demonstrated in a good engineering portfolio. These include the "Analytical Skills", where students should apply their knowledge to solve problems and then critically evaluate their own approaches to solving them (Mourtos, 1999, p. 224). "Experimental Skills" summarise the use of laboratory equipment, the design of experiments and the interpretation of one's own results (Mourtos, 1999, p. 225). The development of computer-based experiments is described in the section "Computational Skills" (Mourtos, 1999, p. 225). The author summarizes the processing and evaluation of open problems under "Design Skills" (Mourtos, 1999, p. 226).

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Finally, "Communication Skills" are also introduced here, in which students improve their scientific communication by writing reports, reviews and reflections or by solving creative tasks, for example by writing poems on technical concepts (Mourtos, 1999, p. 226). This shows an approach how to combine competences with the e-portfolio. While Mourtos relates his competences to the specific subject of aerodynamics, the competences can easily be generalised and extended if necessary.

There are also specific recommendations for the evaluation of e-portfolio in engineering. Doppelt mentions a lack of creative thinking in science and technology education. In his view, creative thinking combines the two components of lateral and vertical thinking. Lateral thinking describes the creative learning process in which a multitude of ideas are collected and developed, whereas vertical thinking is important in the further development of ideas and in deciding which solutions to pursue (Doppelt, 2005, p. 9). From the author's point of view, it is precisely this creative thinking that can be implemented through the e-portfolio in engineering.

"The portfolio reflects what pupils have learned, how they question, analyze, synthesize, solve problems, and create new ideas, and how then design and build useful products or systems. The portfolio also shows how pupils interact intellectually, emotionally, and socially with others."
(Doppelt, 2005, p. 10)

The E-portfolio is advantageous as far as it enables students to generate creative solutions to complex problems and teachers can follow the creative process of finding solutions in detail (Doppelt, 2005, p. 10). Especially the latter is a great benefit for education because it shows teachers how to activate students to work creatively and innovatively. To evaluate such a subjective process the author develops a "Creative Thinking Scale" (CTS) consisting of four levels of achievement (Doppelt, 2005, p. 14). Since the CTS in its original version refers to a specific field of investigation, in the following presentation of the four levels minor changes are made to make the CTS generally applicable to the engineering field as an assessment tool.

1. “Awareness”: The aim is to create an understanding that thinking is a skill that can be developed. For evaluation purposes, comparisons with scientific products, descriptions and explanations of models and constructions as well as examples of solutions to problems can be used.
2. “Observation”: Within this area, the students have to deal with the views of others, consider alternative approaches and observe the consequences of their choices. Evidence for this level includes schematic illustrations of systems or products, presentations of the own planning process and construction phases including all calculations and used programs, justifications of the own selection within different alternatives.
3. “Strategy”: This involves examining the extent to which students can actually use thinking as a competence strategically in order to formulate goals and processes. Here, self-created diagrams, flow charts and structures can be evaluated, as well as descriptions of the planning and construction of models or comparisons of different possible models and the reasoned selection of such a model.
4. “Reflection”: The last level looks at the evaluation of one's own thinking and conclusions drawn from it. Teachers can evaluate the students' reflections - they can examine how the final product meets the students' self-defined learning goals, what conclusions the students draw about the difficulties and successes of the development process, and what suggestions are made for improving their own learning process.

The approaches described above for implementing an e-portfolio in engineering education contexts make it clear that teachers have a wide range of options available for implementing digital collections. While (e-)portfolios have been used more in the creative field in the past, these examples show that digital collections can also be of interest to engineers through more specific adaptations. The definition of competences at the beginning of the course, which can and/or should be achieved in the context of the portfolio, turns out to be particularly important. The competences should be communicated transparently to the students as far as possible and, if necessary, adapted with their feedback.

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The above-mentioned competences are certainly not equally transferable to every engineering seminar, subject or lecture, but they show in an exemplary way which competences can be aimed at with an engineering E-Portfolio. The assessment criteria at the end of this chapter are not universally valid either, but they are a good illustration of how correlations from engineering and the subjective area of creative thinking can be assessed without necessarily limiting the creativity of the learners.

4. Conception of the XP2P project

4.1. Portfolio Platforms

For the purpose of the XP2P project, different e-portfolio platforms were considered. The project partners finally decided to use the open source software Mahara. The following table provides an overview of the programs considered, including the most important features and some notes from the authors. It should be added, however, that there is an extensive amount of different portfolio software available. Furthermore, it is also possible to display portfolios in web blogs, which are intended for the use of diary-like blog posts and not for the explicit design of e-portfolios. In the following table, only those programs are examined which contain explicit usage options for e-portfolios. No claim can be made to completeness.

Platform	Functions	Notes
Mahara	<ul style="list-style-type: none"> • Extensive privacy settings → creator decides what is seen, when and by whom • Special artefact-types: Blogs, planning tools, notes • Comment functions → but not for all artefacts • An URL for an E-Portfolio can be shared → Visibility of the portfolio for external parties possible without an account • Export of portfolios → theoretically lifelong storage and use of the portfolio possible (even after expiration of the account) • Group function for networking • Link to other programs such as Moodle or Olat possible • Numerous extensions through plug-ins, e.g. SmartEvidence for assessment • Artefacts exist independently of the portfolio → an artefact can be used as often as desired in different portfolios/collections, changes in the artefact are simultaneously applied everywhere • Numerous digital formats are available → texts, images, videos, sound recordings, external media, open badges, etc. • Use via mobile devices possible 	<ul style="list-style-type: none"> • Open Source • Active community → online help in case of difficulties/ constantly updated manual/ many multilingual tutorials on YouTube or other platforms • Easy to use → intuitive
Karuta	<ul style="list-style-type: none"> • Extensive assessment-options • Numerous design options for the e-portfolio, and also for the main page • Possibilities to make the evaluation criteria and goals transparent → Students can then track which aspects have already been worked on sufficiently and how close they are to their goals → Learners can submit artefacts directly to specific tasks • Numerous digital formats are available → texts, images, videos, sound recordings, external media, etc. • Portfolios can be shared via e-mail 	<ul style="list-style-type: none"> • Open Source • Training period possibly necessary, not intuitive • Support mostly only in French → Community active, but mostly in the French speaking area • Helpful templates for portfolios and evaluation schemes can be installed, if you research well and/or have good language skills in French

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Platform	Functions	Notes
PebblePad ePortfolio	<ul style="list-style-type: none"> • Special artefact-types: blog • Comprehensive privacy settings → creator decides what is seen, when and by whom • Can be connected to external programs like Dropbox, OneDrive, Google Drive, Moodle • For teachers: PebblePad can identify students who need special help by monitoring their interactions • Extensive feedback-options • Numerous digital formats are available → texts, images, videos, sound recordings, external media, etc. • Use via mobile devices possible • Free design possibilities → design can be creatively designed by the user/ can be personalised 	<ul style="list-style-type: none"> • Simple, self-explanatory handling → Drag and Drop • Subject to charge
OpenOLAT E-Portfolio (Learning Management System)	<ul style="list-style-type: none"> • Special artefact-types: Forum, self-created wiki entry, proof of performance (a certificate issued in and by OLAT about completed tests or submitted and graded tasks), file, text, learning diary, blog → but no embedding of e.g. YouTube videos possible • Comment and star-rating-function • Comprehensive privacy settings → creator decides what is seen, when and by whom 	<ul style="list-style-type: none"> • May require training time → not intuitive • Olat access via university necessary → cannot be used without an account. If individual artefacts are to be used after the end of the study programme, they must be stored separately

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Platform	Functions	Notes
WordPress (Content Management System)	<ul style="list-style-type: none"> • Use via mobile devices possible • Creative design possibilities • Large collection of extensions, add-ons and plug-ins • Pre-designed portfolio designs can be used → facilitates familiarization with unknown formats such as e-portfolios → in some cases for a fee • Can be connected to external programs such as Dropbox and numerous social networks • Numerous digital formats are available → texts, images, videos, sound recordings, external media, etc. 	<ul style="list-style-type: none"> • "Open-Source" → Download free of charge, but use is associated with costs • WordPress is one of the most widely used content management systems → can be a target for cybercriminals • Some functions require knowledge about web design • Active community → online help in case of difficulties • Responsibility for your own website → responsibility for security, back-ups and updates • Handling may require training time → not intuitive • Basics in HTML and CSS are helpful
Elgg (Social Networking System)	<ul style="list-style-type: none"> • Numerous extensions through plug-ins • Comprehensive privacy settings - creator decides what is seen, when and by whom • Special artefact types: Tags, Wikis, Podcasts, Blogs • Comment-functions • Numerous digital formats are available → texts, images, videos, sound recordings, external media, etc. 	<ul style="list-style-type: none"> • Open Source • Active community → online help in case of difficulties • Handling may require training time → not intuitive

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In the following, some important functions of the Mahara-software (which are mentioned in the table above) and how to use them will be presented in detail to explain why the program is particularly suitable for the XP2P project.

Groups can be used in the project on three levels: A general group can be used to network students from the participating partner universities. At a middle level, groups can be created for the individual lectures/seminars/projects. At the lowest level, the small groups within the lecture/seminar/project can network. The latter is particularly important in the context of peer-to-peer learning.

The plug-in "*SmartEvidence*" enables the embedding of a competency framework in Mahara, allowing students and teachers to track which competencies have already been acquired and which have not yet been started or sufficiently developed. The competences are not fixed and can be individually designed. Chapter 4.4 will provide an insight into important competences within the XP2P project.

Comments can be written on individual artefacts (blogs, images) or on the portfolio as a whole. In the context of the XP2P project, the commentary function is necessary for the communication between teachers and students and for the students with one another.

In general, a wealth of common artefacts such as *images, text, sound recordings, videos, PDF files, external links, media and social networks, as well as personal biographical information* can be embedded within the e-portfolio. In addition, there are some more specific artefacts that expand the creative design scope. These include the following artefacts:

- *Tags* are keywords that can be assigned to an artefact by the creator. Thematic tags are particularly relevant for the collection of artefacts. Especially in the initial phase, students tend to collect all materials that are considered relevant. By using the tags they can organize the elements thematically, artefact-specific or individually categorized. When creating the e-portfolio, the necessary artefacts can then be searched for and compiled more efficiently using the tags. This is therefore not a required presentation element, but merely a recommendation that focuses on the students' organizational skills and makes their work easier.

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- *Blog*-entries should be used as a tool for reflection, as they contain data on creation and modification and can also be individually commented on. The important character of reflections makes it necessary to have an instrument that lecturers and students can respond to directly through comments. Since fixed submission dates for reflections are planned throughout the semester (only applies to HSKL), an artefact that is dated is a mandatory requirement.
- The *planning tool* in Mahara can be used to track the students' organizational skills and project management approach. Plans of the groups can be published beforehand and the teacher can check if all aspects have been considered and finally the planning can be reviewed and it can be checked if all planning fragments have been implemented. This has two advantages: on the one hand, the lecturer is able to follow the planning and on the other hand, the students can check for themselves whether aspects have been omitted, forgotten or insufficiently dealt with.
- *Notes* are a way to record important elements such as definitions, mathematical formulas, data, etc. The special thing about notes is that they can be inserted into different portfolios as often as desired. If a note is edited, the editing is transferred to all portfolios in which the note is used.

Overall rated Mahara is a very easy to use platform. The basic functionality of portfolio creation is intuitive and suitable even for inexperienced users. Especially the simplicity of the software makes it attractive for the project, as the engineering sections of the participating universities still have little practical experience with e-portfolios. A complicated program could discourage students as well as teachers and have a negative impact on the project. However, the simplicity does not reduce the quality of the program, as it offers all the functionalities necessary for the project. It should be added, however, that there is also the possibility of adding plug-ins to additional functions, although this requires additional research and training. Through a very active online community in forums and social networks it is easy to get help for this purpose.

The didactic designs of the e-portfolio within the XP2P project will now be explained in detail in the next chapter.

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4.2. HSKL and TUCN proposal of a didactic portfolio concept

The project members from Kaiserslautern University of Applied Sciences and the Technical University in Cluj-Napoca have developed a joint concept for implementing the portfolio method. For this purpose, a joint use of the HSKL Mahara platform was decided and made available to the teachers and students of TUCN with all necessary rights.

In order to represent the e-portfolio method authentically, an e-portfolio was created that reflects the didactic concept. This can be accessed under the following link: <https://mahara.vcrp.de/view/view.php?t=QcDtWuFkwZEi5AXvlhyn>¹. This type of presentation has a number of advantages - it primarily serves as an example for students and teachers of how an e-portfolio can be designed. It makes the requirements and expectations for the design of the e-portfolio as transparent as possible for the students. The presentation of the concept in the programme shows the students that the teachers have also dealt with Mahara in detail. In addition, it is an opportunity to pass on further information to teachers and students in the form of the IO5 and the literature sources cited therein. The commentary function also provides the opportunity to ask direct questions about individual aspects of the concept. A lively exchange in the proposed concept can also lead to its optimisation and is therefore desirable from the point of view of the authors of this paper.

Before presenting the didactic concept that has been created, it should be mentioned that the focus here is on a general design of the e-portfolio in engineering. Additionally, overlaps to peer-to-peer elements from the XP2P project will be drawn. Concrete contents of lectures will be left out, since there are significant thematic differences between the project partners regarding those contents and the objectives and design of the courses are left to the respective teachers themselves.

For the purpose of the XP2P project, the definition of the e-portfolio in chapter 2 was determined as follows:

¹If the link is no longer accessible, it is possible to download the export of the portfolio on the following page: <https://xp2p-project.eu/>

An e-portfolio is a digital collection created to assess learning progress and includes multimedia evidence of students' efforts and skills. A special role in this collection is taken by reflections that support a critical examination of individual learning behaviour and promote exchange with the viewers of the portfolio. The creator of the e-portfolio is its owner, who shares content in order to improve her/his learning, thus the intrinsic motivation of the student is emphasized.


The central objectives of the e-portfolio result from this definition: The implementation of peer-to-peer learning, which is the aim of the XP2P project, is to be followed through the digital collection - learning progress and difficulties that arise in the students' learning from and with each other are documented in the e-portfolio by the students in their artefacts and the formulated reflections. The digital exchange in the commentary functions can provide information about the dynamics of the groups in the lectures. In addition, the e-portfolio is then a means of mapping and evaluating individual student performance. In this way, it can be checked which competences have been acquired by the students during the semester and to what extent necessary knowledge has been acquired. This has two advantages during the course of the semester. On the one hand, individual assistance can be provided in time before the final evaluation in case of difficulties which might not have been noticed in the group work. On the other hand, a "free-rider problem" can be avoided, which arises when individual group members take advantage of the group work without making relevant contributions themselves. The additional individual work on the e-portfolio and especially on the reflections forces every learner to go over the results of the group work and to look at them from a personal perspective.

The following figures show the didactic concept for creating the e-portfolio in the XP2P project. Like a classical scientific paper, it is divided into an introduction, a main part and a conclusion.

The introduction should be an occasion for the students to deal with the portfolio work as a whole. At the beginning of the semester, they should develop initial ideas about how they want to approach their e-portfolio strategically and which aspects they need to consider. Furthermore, the introduction guides the students to work with reflections. To do so, they should relate what they have learned in their previous studies to the respective lecture and

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their expectations of it. In this context, the students can already set the first priorities for their digital collections and thus name competences they would like to acquire during the semester. In this way, the students deal in detail with the further course of the semester right at the beginning and reflect on what they have learned in their previous studies. This gives them the opportunity to refresh their existing knowledge and put the current lecture into an overall context. The open structure allows students to set their own personal focus, which can be beneficial for lifelong learning processes.

 Entry Reflection

📅 Posted by Marina Zingraf on 17 April 2020, 10:33 AM
🕒 Last updated 03 August 2020, 11:25 AM

Introduction/ exposé: Presentation, delimitation & justification of the choice of topic. Forecast of the portfolio.

Reflection of the own learning process is a requirement for a successful portfolio. In doing so, it looks back at what has been worked out so far: What has been learnt should be placed in an overall context and viewed critically.

The reflections should be scientifically sound and combine knowledge and competences already acquired in other lectures and seminar units as well as in the Bachelor's programme. Or show which aspects have been neglected in learning so far and are taken up by the respective lecture. Assistance can be provided by means of pre-fabricated forms containing open questions that the students can address.

- Which focus do I choose for my portfolio? Why?
- What knowledge do I already have on the subject?
- How do I want to approach the portfolio strategically?
- At which points do I possibly need assistance?

Important! Use blog entries for reflection. Allow comments. This allows the exchange to take place explicitly at the artifact.




 Comments (1)
 Add comment
 Details

Figure 1: E-portfolio Introduction

As mentioned earlier, Mahara's commentary features are meant to be used to communicate with fellow students and teachers. The communication can take place directly at individual artefacts, or at the end of the e-portfolio in the final comment field (see Figure 6). The former has the advantage that the particularly important reflections can be addressed directly, and discussions can take place on very specific aspects. This avoids the final comments going into too much detail, making the discussions confusing.

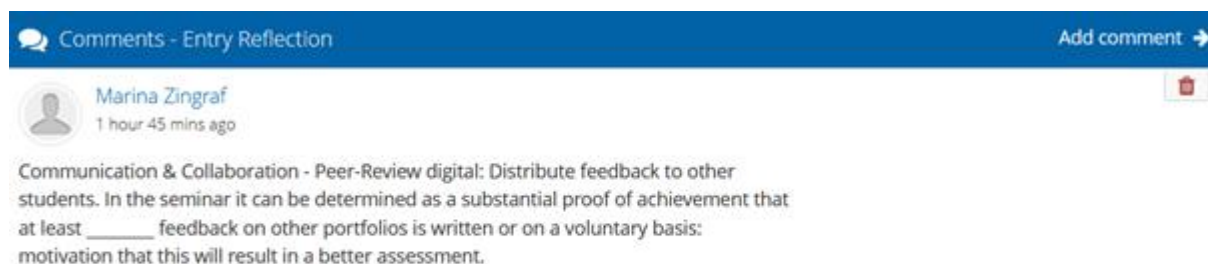


Figure 2: Comments on artefacts

The main part is the most important part of the digital collection. It is used to present the collected artefacts - here students are supposed to compile their own media, but they can also insert research material and provide evidence of their analysis of these materials. As in any scientific work, it is important to include references. Since in the case of the XP2P project the learning progress of the students is checked, a continuous work on the e-portfolio is assumed. This is especially true for the reflection units, which have to be written by the students at regular intervals. Until the final delivery of the e-portfolio, everything except the reflection units can be changed and rearranged in the portfolio. For the sake of clarity, it is specified that students number their artefacts in the title. This also facilitates communication about artefacts in the final comment field.

A. Directions

The **aim** of the portfolio: documentation of the entire individual work process and interim results. The portfolio serves as proof of performance. It is therefore important that the portfolio does not dull all artefacts found, but only the best ones, with content relevance that also fits the structure of the portfolio and the (self-)set learning goals. The portfolio can be seen as a kind of showcase: A store does not display all its goods there, but only a fraction of them, which is considered relevant & representative.

Important! Content connections must be made clear! If it is not possible to show connections by the mere form, it is possible to describe and justify the connections by means of written explanations / comments.

Inappropriate representations are: Copies of boards, other people's work or literature that has not been further processed. Instead, sources from others (i.e. definitions, diagrams, graphs, etc.) can be used to supplement one's own work process and to show which impulses have promoted independent work.

Note: Artefacts must be marked and provided with a short title or link if they are another party's intellectual property.

1. Engineering



Add comment

Details

2. Competency Portfolio Assessment guidelines



3. The Octo-Bouncer



4. Semester Tasks

Tags: eLearning, mechatronics, portfolio

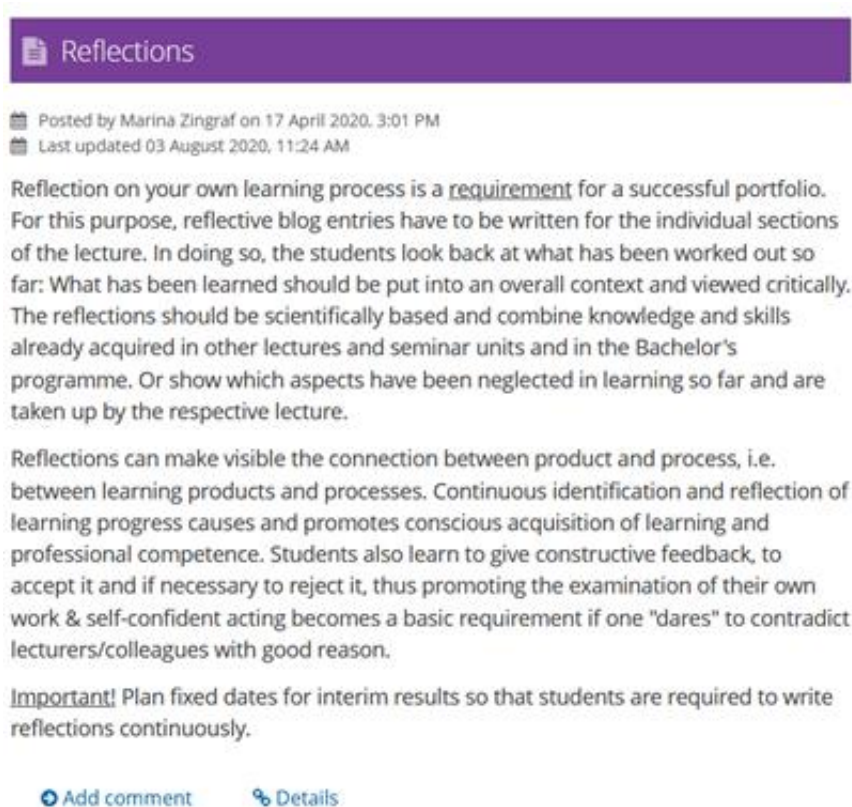
plan group meetings - Completion date: 26 March 2020

Figure 3: Main part

For the reflections, the blog function in Mahara should be used. Previously it was already mentioned that the reflection units of the students have to be written in regular intervals, i.e., they have fixed deadlines in the semester. The special feature of the blog entries are the time notes "Posted on..." and "Last updated...", which makes it possible to see whether the reflections were submitted on time and whether work was still being done after the official deadline. It is a control mechanism to ensure the continuous work on the e-portfolio. It also counteracts the danger that such an open and creative tool as the e-portfolio is seen as a voluntary extra task and is not taken seriously. In terms of content, the reflection units refer

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to own learning progress in the lecture/seminar/project. What has been learnt should be applied to competences that are acquired or deepened through the work during the semester. The design of the reflection units can be left open for the students - they can justify the common thread and thus the strategic approach to the portfolio; explain problems in lectures and reveal their possible solutions; analyse important models, graphs, diagrams etc. with the help of the knowledge acquired; place lecture units in the overall context of the course of study or relate them to professional goals; or answer specific questions from the lecturer. If one wants to guide the students' reflection units in a certain direction right from the start, it is advisable to communicate important goals of the reflections to the students at the beginning of the lecture and to clearly express the expectations. Since engineering students often have little experience with self-reflective work in higher education, clear and transparent communication with the students is of particular importance.



Reflections

Posted by Marina Zingraf on 17 April 2020, 3:01 PM
Last updated 03 August 2020, 11:24 AM

Reflection on your own learning process is a requirement for a successful portfolio. For this purpose, reflective blog entries have to be written for the individual sections of the lecture. In doing so, the students look back at what has been worked out so far: What has been learned should be put into an overall context and viewed critically. The reflections should be scientifically based and combine knowledge and skills already acquired in other lectures and seminar units and in the Bachelor's programme. Or show which aspects have been neglected in learning so far and are taken up by the respective lecture.

Reflections can make visible the connection between product and process, i.e. between learning products and processes. Continuous identification and reflection of learning progress causes and promotes conscious acquisition of learning and professional competence. Students also learn to give constructive feedback, to accept it and if necessary to reject it, thus promoting the examination of their own work & self-confident acting becomes a basic requirement if one "dares" to contradict lecturers/colleagues with good reason.

Important! Plan fixed dates for interim results so that students are required to write reflections continuously.

[Add comment](#) [Details](#)

Figure 4: Reflections

A concluding reflection is expected from the students in the final section. Here they should draw a summary of their portfolio work during the semester. The students should describe how they felt about working with the e-portfolio and whether they would describe it as a helpful tool overall. They should also deal with the content of the lecture and relate it to the acquired competences. In figure 5 below, questions are formulated which can also serve as an aid in writing the final reflection. In addition, a bibliography must be included in the final section if third-party intellectual property has been used.

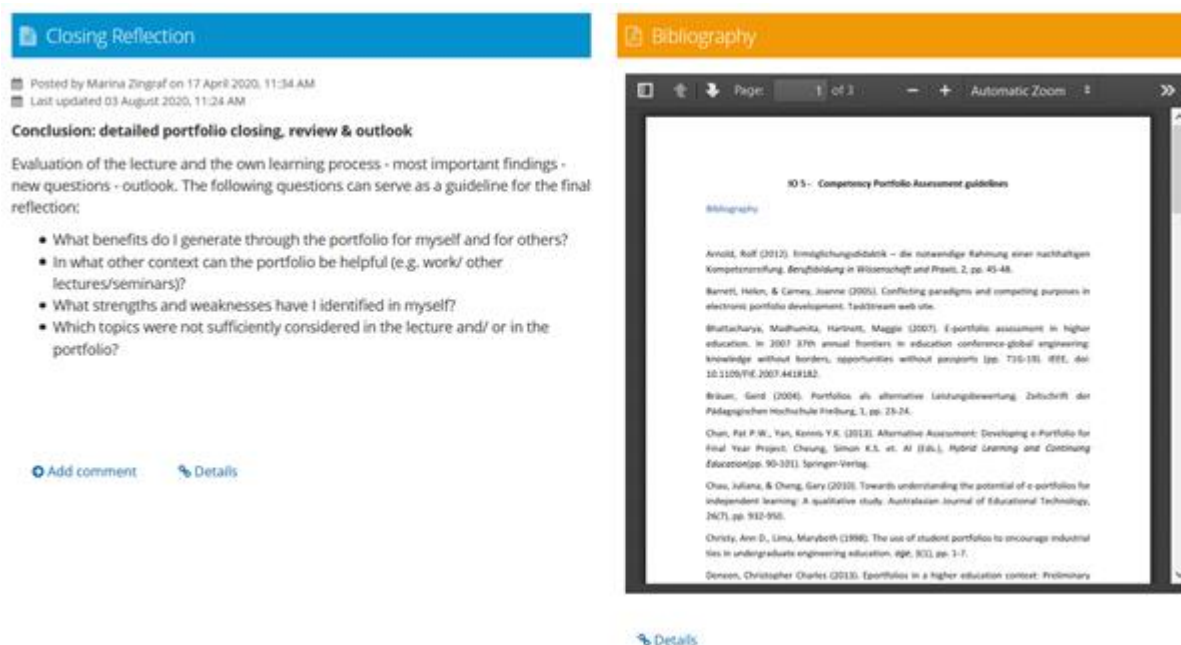


Figure 5: Closing section

The final comment function is to be used by teachers and students for communication purposes. Since individual artefacts can be commented on directly, it is recommended to use the comments in the final report for the overall construction of the portfolio and to address individual artefacts only if they cannot be commented on specifically in Mahara. If individual comments are considered too personal, they can be submitted in such a way that only the creator of the portfolio can see them. However, since communication among students is an important aspect in the evaluation of overall performance, it is recommended that private comments are only written by teachers if they are afraid that the students concerned might

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feel uncomfortable with particular statements. Comments should not be perceived by students as "commands", but should instead encourage them to deal more intensively with areas in which they have difficulties or a change of perspective would be necessary. Teachers are therefore recommended to refrain from statements that describe what would be correct. Instead, comments should provide food for thought and only intervene in the event of serious mistakes and misunderstandings.

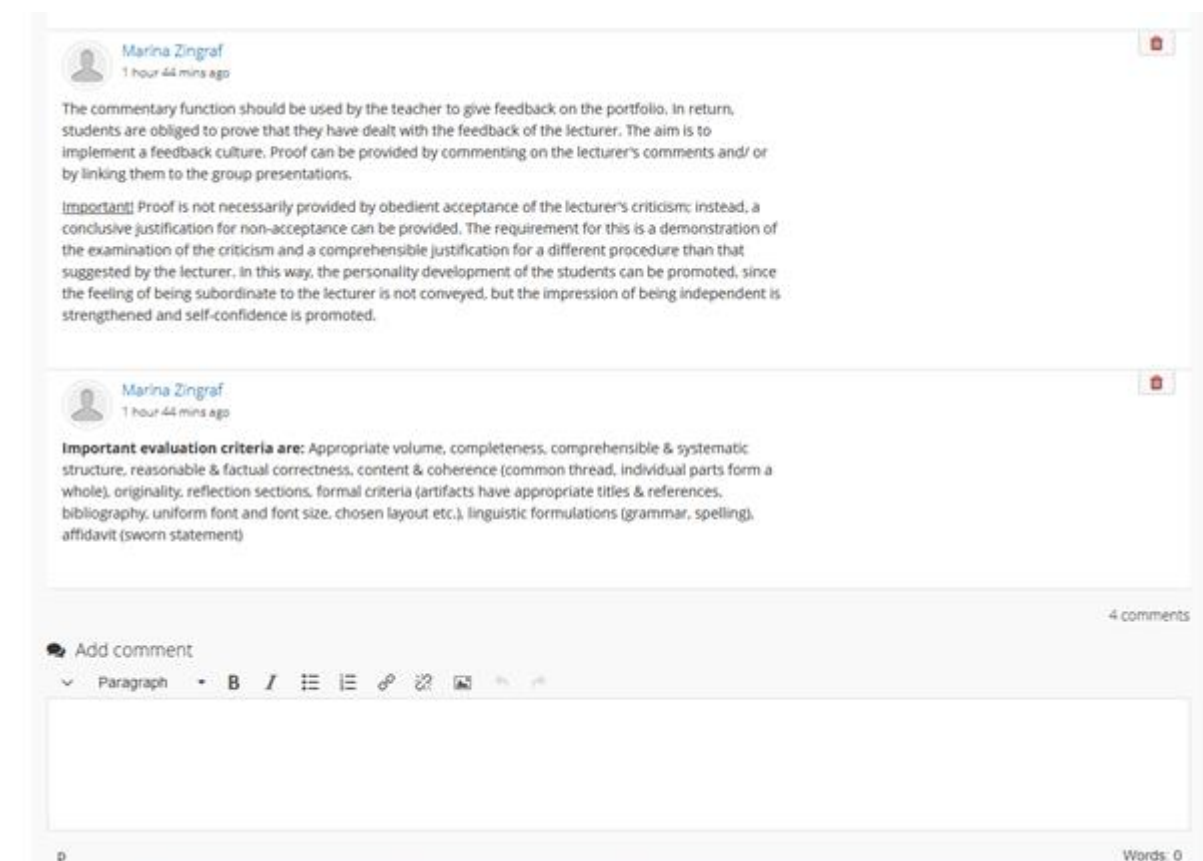


Figure 6: Final comments - feedback and communication on the whole e-portfolio

4.3. USMB proposal of a didactic portfolio concept

The interest of the e-portfolio is to lay the foundations for:

- Transforming practices for a better efficiency of pedagogical devices, in line with the construction of a knowledge society: current models of pedagogy were born from the requirements of an industrial society in search of mass education that are no longer necessarily adapted to the demands of a knowledge economy.
- Setting up a system of quality assurance of learning (traceability): the e-portfolio offers the opportunity to create relevant traces from which information can be extracted from which a reflexive process of reflection by all the stakeholders of the educational institution can be initiated.

It is a tool for communicating and engaging in a reflective approach to learning. In order to specify its functions, its use and its multiple definitions, a mind map has been created (*appendix 1: e-portfolio mind-map*). This enabled us to work together as a team with common definitions and objectives.

The e-portfolio seems to be very interesting during the Covid crisis. Indeed, students and teachers team need social links and sense. Students' motivation has to be developed and a pedagogical team must guide and help students not to break the link and lose the motivation for studies.

The construction of an e-portfolio should ideally be integrated into the student's learning activities and the institution's pedagogical and administrative processes without constituting an additional burden.

4.3.1 Steps to implement the e-portfolio tool

Several steps seem to be essential in order to implement an e-portfolio device in higher education.

The pedagogical team of the Master Advanced Mechatronics in Annecy made the choice to follow the following steps:

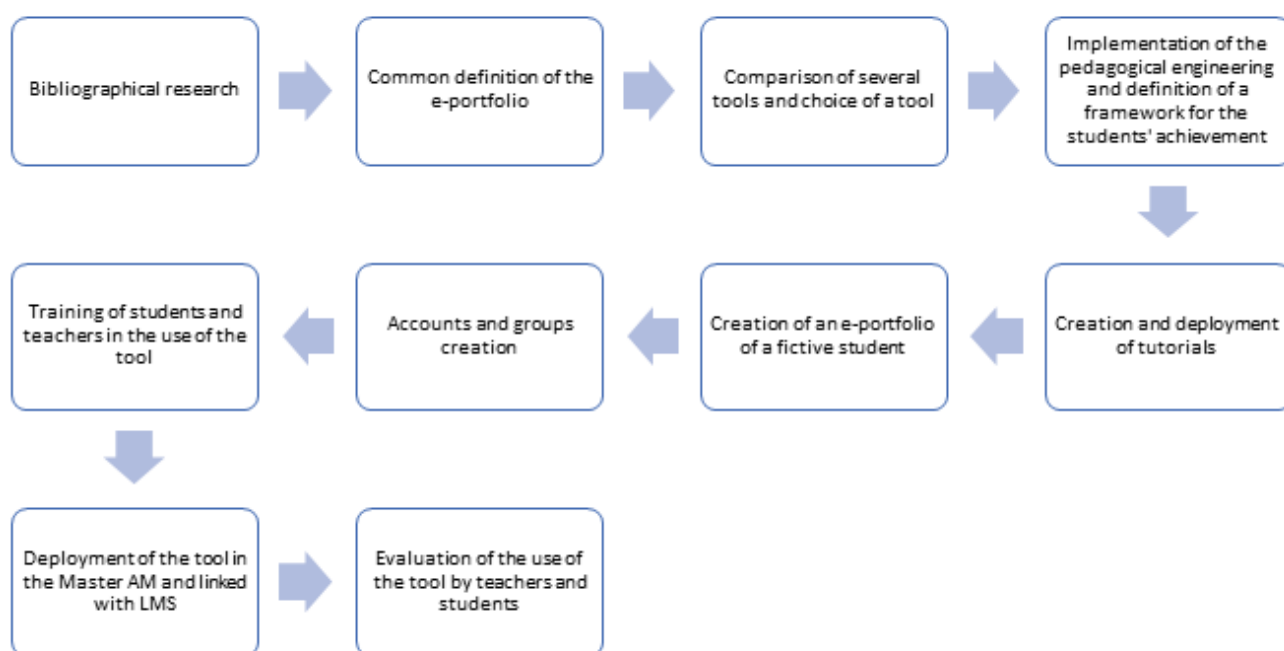


Figure 7: E-portfolio deployment steps at USMB

4.3.2 E-portfolio platform

The Mahara platform is the one chosen to develop the e-portfolio of the Master's students. This platform is flexible and will certainly make it easier and quicker, moreover, this tool is already used by the Kaiserslautern University HSKL and it seems easier to work together with the same numeric tool.

The SmartEvidence plugin has been installed in order to create and implement skills repositories in the e-portfolio tool (*appendix 3*). Students and teachers can thus assign themselves or assign levels of competency attainment. The Master's competency repository has also been implemented on Mahara. Each time it is associated with a collection, the competency grid appears each time it is associated with a collection on the first page of the collection.

USMB uses the LMS platform Moodle to propose hybrid learning to the students. A Mahara/Moodle ecosystem has been created to diversify the pedagogy implemented in the Master by linking a teacher-centered LMS platform to a student-centered e-portfolio platform.

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, in particular thanks to the external tool activity
- To post Mahara pages or collections in Moodle through the Moodle Assignment activity
- Export content from Moodle to publish it in Mahara

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.

4.3.3. *Pedagogical methods to develop e-portfolios*

4.3.3.1. *Pedagogical Framework*

The creation of a specific course for the creation and feeding of the tool by students is interesting because it can accompany learners in the handling of the tool and the implementation of reflective learning. A proposal is made in this sense (*appendix 2: pedagogical engineering of e-portfolio course*).

For this purpose, a course proposal on the theme of the e-portfolio was written in order to frame its realization and to help students in their achievements.

Its main objective for students is to promote, measure and value the development of their skills.

The specific objectives are to:

- Engage in a reflective learning process by critically observing one's own learning, ambitions, strengths and weaknesses.
- Keep a chronological and thematic record of the activities undertaken during the year and their results (evidence).
- Select, organise and publish evidence for presentation at a particular audience.
- Assess and highlight skills and readjust objectives.

In order to achieve these objectives, a series of tasks and activities is described in a pedagogical engineering document that can be used during the student orientation week at the beginning of the academic year. It is desirable to extend its use to the entire programme

To do this, support for the process and the tool must be deployed from the beginning of the training in the presence and/or in the form of a virtual classroom. Regular distance and/or

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face-to-face meetings must then be set up for all the students and a calendar provided at the beginning of the semester and giving precise dates and expectations of the work to be done. A final summative evaluation and formative interim evaluations may then be considered to assist the student in the construction of his or her digital portfolio. Peer evaluation can also be used here, particularly in the form of comments on other students' pages and collections.

In practice, it is advisable to propose to students to build up an e-portfolio with regular feeds for the whole programme.

The creation of collective portfolios for group projects (two per semesters in the master in Advanced Mechatronics at USMB) is also a useful means of fostering collaboration and exchange, and thus peer learning.

It seems interesting to the pedagogical team that the student e-portfolio should include the following points:

- a logbook fed regularly in order to implement a reflexive learning approach. The students can then choose a rhythm by which they will write articles in their logbook in order to regularly come back to what they have learned and to the skills they are developing.
- collections of pages for each project and course unit presenting evidence of learning and corresponding journal articles. These pages should highlight the skills developed during the year.
- the use of SmartEvidence for all collections, to show the skills developed and their level of acquisition.
- the use of group e-portfolios for collective and collaborative work on projects.
- the sharing of pages between students, with teachers and with the partner universities of the XP2P project with the use of comments and "submissions for evaluation". The e-portfolio tool supports the peer learning process because students can work on common pages and collections, comment on the productions of their peers, but also with a collective e-portfolio.

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4.3.3.2 A fictitious student account

The creation and feeding of an e-portfolio must be framed and accompanied.

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

- The creation and sharing of pages and collections
- Feeding a blog type logbook
- The creation of a CV
- Badge sharing
- The use of skills repositories

The fictitious student account has been created to serve as a model for M2 students.

This account provides a framework for students to help them build their e-portfolio but leaves them free to demonstrate their creativity and to develop this tool according to their needs, objectives and specificities.



Elsa Master

Se connecter comme elsmaster

Paramètres du compte

Envoyer

Envoyer une demande de contact

Membre de C2i Formation

This is a fictitious student account. It has been created to present a Mahara e-portfolio template.

Holder of a Master's degree in computer science, my professional project is to work as an aeronautical engineer.
For this, I am currently studying for the Master Advanced Mechatronic at the Polytech school in Annecy.
Within this framework, I have started the realization and the feeding of an e-portfolio. So I present here my skills and projects related to learning proofs.

In the Master AM

The skills developed in the Master AM

Individual project semester 9

Open badges and competencies

Badge XP2P

Communication badge



Individual project semester 9

par Elsa Master (elsmaster)

During the S9 individual scientific writing project, I had to put into practice my scientific and technological knowledge as well as my thinking skills (reasoning and drawing conclusions) to write a scientific paper.

I wrote it from my results of my previous collective research project in order to prepare a paper detailing a state of the art on a research topic, reusable for a complete scientific paper.

I had improve my writing and thinking skills, my know-how in bibliography management and I have deepen my knowledge when necessary through lectures, discussions with staff and peers and through on-line learning.

The 3 main competencies that I have developed in the master's program are:

- Design and achieve a mechatronic system
- Master the skills required for research activities
- Manage a research project

Unit	Competencies	Acquisitions	To improve	Good	Excellent	Excellence
1. To improve an acquired process of multi-phases and multi-steps: modelling, simulation and design	The student is able to design a multi-phases process. The student is able to design a multi-phases process. The student is able to design a multi-phases process.	The student is able to design a multi-phases process. The student is able to design a multi-phases process. The student is able to design a multi-phases process.	The student is able to design a multi-phases process. The student is able to design a multi-phases process. The student is able to design a multi-phases process.	The student is able to design a multi-phases process. The student is able to design a multi-phases process. The student is able to design a multi-phases process.	The student is able to design a multi-phases process. The student is able to design a multi-phases process. The student is able to design a multi-phases process.	The student is able to design a multi-phases process. The student is able to design a multi-phases process. The student is able to design a multi-phases process.
2. To design, develop and implement the required system	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.
3. To design, develop and implement the required system	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.	The student is able to design, develop and implement the required system. The student is able to design, develop and implement the required system.

Figure 8: The Mahara fictitious account

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4.3.3.3. Student testing of Mahara

The XP2P project has been developed with the aim to introduce pedagogical innovation within the Master Advanced Mechatronics, in particular by offering students more peer learning activities but also through the use of a learning e-portfolio. The Mahara platform has been used initially in the first semester of the second year of the Master programme in Advanced Mechatronics. In this context, a preliminary test was lead with a few students to collect their opinion and their feelings about the use of this platform before implementing the tool for the whole class.

A test of the Mahara platform was therefore carried out by 3 students of the USMB in summer 2020. The objectives of this test were:

- To make the objectives of the Mahara platform test understood by the students of the Master in Advanced Mechatronics at USMB
- To create and share pages and collections
- To create a journal and articles
- To load content into a Mahara e-portfolio
- To view Mahara's pages and collections on Moodle
- Find out more about the resources and activities of the e-portfolio test course on Moodle

A course area on Moodle has been indeed specifically created for the Mahara test (E-portfolio Test).

It included:

- Exchange spaces such as forums and chat rooms
- Resources on the Mahara platform (technical, pedagogical, video and text)
- Activities to be carried out to test the platform
- A survey on the use of this tool and the collection of students' opinions and satisfaction with its use.

Figure 9: The Moodle course for student testing of Mahara

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A Mahara account has been created for each student participating in the test. Students were invited to join the Mahara E-portfolio Test group.

A specific technical tutorial was shared with students directly on Mahara in the form of a collection. It covers the technical aspects that can be used during the test and is complementary to the resources offered in the E-Portfolio Test Moodle course .



Figure 10: Mahara tutorial

The main task to be carried out by the participating students was to create an e-portfolio with the following contents:

- A profile page with at least one photo and a presentation text
- At least one newspaper article explaining for example work done during a Master project or a course
- A collection of pages (two at least) presenting two skills developed during the Master's course (*appendix 3: Master AM's skills*) and proposing the articles of the previously written journal related to evidence of the acquisition of these skills (report, image, slide show, website etc.)
- The integration of the SmartEvidence Framework into the collection

The students had to share their pages with the E-portfolio Test group.

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The test began with videoconferences with the students in order to present the objectives of the test, the work instructions, the e-portfolio system and the Mahara platform.

The students then worked remotely and independently.

At the end of the test, they were asked to participate in a digital survey and a debriefing meeting to share their feelings and impressions.

4.3.3.4. Mahara students training

Students must be trained in the use of the e-portfolio and Mahara. This has been done at USMB:

- by demonstration sessions (notably in videoconference when the University was closed because of the Covid crisis).
- by a course on the University's Moodle platform presenting:
 - spaces of exchanges on the e-portfolio and the Mahara platform.
 - resources such as video and text tutorials
 - application exercises to be carried out on Mahara on the notion of e-portfolio, reflexive learning and on purely technical points such as creating and sharing pages, creating articles and journals, loading content, teamwork with the group e-portfolio.

Exchange area

 Virtual class of introduction to Mahara

 Mahara Technical Forum

Ask here your questions and technical problems about the Mahara tool.

 Forum on e-portfolio content

Here you can discuss the content of your e-portfolio and the concept of reflective learning.

 Chat

Synchronous exchange space on the e-portfolio system and the Mahara tool.

The e-portfolio

Collaboration work.


With the help of the course resources and by carrying out a bibliographical research, you will make a **video presentation of the Eportfolio tool**.

You will answer the following questions:

- **What is an e-portfolio?**
- **What is reflective learning?**
- **How can this tool help me in my academic and my professional career?**

Your video will not exceed **3 minutes** and you will post it on the **forum** of this section using this button :



 Exchange space concerning videos on the e-portfolio

After posting your video in this forum, you will comment on the videos of the other students by answering these questions:

- Does the video answer the 3 questions asked by the teacher?
- Is the video clear and of good quality?
- Is the maximum time of 3 minutes respected?


Finally, you will discuss the differences you find in the content of the videos of the other students.


Figure 11: The e-portfolio Moodle course (1/3)

Get start using eportfolio and

 [What is an e-portfolio?](#)

 [Mahara introduction](#)

 [Edit your profile page](#)

 [Start using Mahara](#)


The objective of this activity is to start feeding your e-portfolio.

To do so, after consulting the resources made available to you, you must update your **profile page**.

Ideally, you should post at least one photo and a presentation text.

Please post your profile page here.

Create journal and articles.

 [Mahara access](#)

 [Mahara page about journal and articles creation](#)

Learning activity : we suggest you to create your first article after having read the tutorials above. You will write an article on how you have lived this first month since the beginning of the academic year.

Figure 12: The e-portfolio Moodle course (2/3)

Work in teams on mahara.

 [Mahara access](#)

 [Official Mahara tutorial : groups](#)


 [Create a group](#)

This video shows you how to create a group and join.

Learning activity : you have to do a group work for the Robocup project. To do this, we suggest you create group e-portfolios and work by performing the following tasks:

- designate your project manager to create a new group.
- join this group once it has been created
- communicate via the group's forum
- contribute to the group's journal to show the progress of your work.

Download content.

 [Mahara tutorial : download content](#)

Learning activity : after reading the tutorial to download the content on Mahara, you can choose proofs and files that allow you to show your skills (CV, reference letter, photos, videos, project files, diagrams, plans etc.).


Then you can link these proofs with articles explaining how you got it and share them with others in pages.

Create and share pages in your e-portfolio.

 [Video tutorial : creating pages on Mahara \(in French\)](#)

 [Mahara page about pages creation](#)

 [Mahara access](#)

 [Post a collection of your e-portfolio](#)

The objective of this activity is to start to feed your e-portfolio.

To do this, after having consulted the resources made available to you in the specific space of Moodle, you must :

- create a collection on the skills you have already developed with the creation of several pages each presenting a skill of your choice and corresponding evidence
- integrate into your collection, the global table of competences (smartevidence)

Figure 13: The e-portfolio Moodle course (3/3)

4.4 Levels of competence

The following table shows competences that can be acquired in the XP2P project through portfolio work. Some of the competences are not exclusively acquired through the work on the e-portfolio but are enhanced by it. For example, the ability to give constructive feedback and to deal with feedback can be acquired through communication in Mahara as well as through group work during the lecture. Therefore, an area for "evidence in the portfolio" has been added to the table, which refers to the work on the digital collection, but does not exclude the possibility that the competences are also acquired elsewhere. The competences are based on the specifications of the lectures/seminars/projects involved in the project and on the scientific references in chapter 3. As mentioned before, specific contents of the lectures are left to the teachers themselves, so there are no competences in the table that are based on specific knowledge.

Skill	Essential Components	Main Expectations	Evidence in the e-portfolio
Learning	Learning how to learn new things and apply them in different situations	<ul style="list-style-type: none"> Develop learning strategies Filter necessary knowledge Transferring knowledge to new situations Development of alternative problem solutions 	<ul style="list-style-type: none"> Transfer of the learned contents to the e-portfolio and its design Reflections of own learning strategies
Self-Assessment	Critical examination of own learning	<ul style="list-style-type: none"> Critical examination of own learning and own approaches to solutions Consideration of alternative solutions 	<ul style="list-style-type: none"> Honest reflections that question one's own learning behaviour, admit difficulties and strive to optimise one's own learning
Analytical Thinking	Application of knowledge to solve complex problems	<ul style="list-style-type: none"> Critical examination of different approaches to solutions Development of innovative solutions 	<ul style="list-style-type: none"> Documentation of the solution approaches in the artefacts → e.g. graphs, analyses, calculations Reflection of own strategies in problem solving
Digital Skills	ability to use media for communication and practical purposes	<ul style="list-style-type: none"> adaptability to work with new, developing media Responsible handling Clear & appropriate communication with teachers/ fellow students 	<ul style="list-style-type: none"> Safe handling of Mahara and its functions Use of the extensive functions of the software Communication via comment and group functions
Feedback	Constructive examination of other people work & analytical handling of feedback on own work	<ul style="list-style-type: none"> Critical examination of other work → Constructive support for optimisation Differentiated handling of feedback on own work → does not show itself in the obedient acceptance of feedback, can also be presented in a well-founded discussion 	<ul style="list-style-type: none"> Thoughtful & constructive feedback in the comment areas of the other students Dealing with the comments in your own portfolio → Presentation of the acceptance of the feedback or justified rejection
Communication	Effective written communication of one's own work & one's own examination of other works	<ul style="list-style-type: none"> Understanding of good scientific documents in the engineering sciences 	<ul style="list-style-type: none"> Analysis of scientific documents Collection of own scientific papers Feedback on other e-portfolios

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Skill	Essential Components	Main Expectations	Evidence in the e-portfolio
Manage a research project	Organizing own activity & the activity of the team	<ul style="list-style-type: none"> • Project management approach • Integration into the team • Adequate planning & reporting 	<ul style="list-style-type: none"> • Organisation of the portfolio work / team work • Communication in the comment section • Planning tools
	Reporting to the research program manager	<ul style="list-style-type: none"> • Overview of the project progression • Clear & reusable presentation • Integration into the team • Timely & appropriate reporting 	<ul style="list-style-type: none"> • Communication in the comment section: response to feedback, interaction with fellow students • Completeness of the portfolio • Punctual submission of the reflection artefacts
Research	Managing scientific knowledge & understanding of intellectual property issues	<ul style="list-style-type: none"> • Antiplagiarism behaviour • Examination of bibliographic materials • Correct citation of resources used 	<ul style="list-style-type: none"> • Structured and complete biblio-webo-graphy • Citations of resources used

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5. Conclusion

At the beginning of this paper, it was discussed why the e-portfolio in particular can be a useful instrument in higher education. Thus, the digital collection aims at the process of the acquisition of competences, which combines both the specifications of the teachers and the individual priorities of the students. On the one hand, the students are clearly expected to take responsibility for their own learning and individual approaches are rewarded. Teachers, on the other hand, offer support in the learning process, provide their own experience and give important impulses. In this way, different life situations of adult students can be taken into account in the e-portfolio and teachers change from their role as knowledge mediators to that of learning guides.

Based on the requirements of higher education and the different application and definition possibilities of an e-portfolio, it was defined for the purpose of the XP2P project as follows: The e-portfolio is a digital collection that is created to assess learning progress and contains multimedia evidence of students' efforts and competences. A special role in this collection is taken by reflections that support a critical examination of individual learning behaviour and promote exchange with the viewers of the portfolio. The creator of the e-portfolio is its owner, who shares content in order to improve her/his learning, thus the intrinsic motivation of the student is emphasized.

With the help of the definition and the scientific literature, an overall didactic concept was then developed, which is aimed at both students and teachers. It was pointed out that portfolio work for teachers starts with defining learning goals and purposes, as well as evaluation criteria associated with such a digital collection. Furthermore, it is recommended to formulate tasks at the beginning of the course which serve as a focus at the beginning of the lecture, but which can be extended by additional tasks in the course of the semester. Special attention should be paid to the formulation of such tasks. Questions and tasks should be formulated in a semi-open way and adapted to the students' reality. This first preparatory step is only considered complete when the criteria mentioned have been communicated transparently to the students. To improve communication, it is suggested to provide a reference portfolio. This will give students a better understanding of the demands that the

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teachers are pursuing with the e-portfolio and provide them with a basic structure to which they can refer during the course of the semester. For the students, the actual work begins with the collection of artefacts. These include products and representations of learning processes. For the students, this is a creative process, the development of which is determined by them and which is in constant change until the final submission of the portfolio. An exception to this are reflections, which continuously and critically examine individual learning processes throughout the semester. Since students analyse their learning status at different points in time and assess their own learning development on the basis of this analysis, it is not recommended to change the reflections in an e-portfolio as described in this paper at a later date. As an aid to formulating reflections, it is recommended that uniform questions be given as a guideline, which will also make it easier for teachers to evaluate the reflections. In order to make the learning progress more comprehensible, introductory and final reflections were also presented. These can show the students' level of competence and knowledge at the beginning and end of the lecture. Thus, the individual progress can be honored in the final evaluation of the e-portfolios. Furthermore, insights into the perception of the portfolio work are gained, so that the work processes can be optimized for future lectures. Another important element of the portfolio work is the feedback, both from teachers and fellow students. It is necessary to make students aware of the advantages of a feedback culture, so that they are motivated to critically examine the portfolios of their fellow students and at the same time want to deal with feedback on their own portfolio in detail. After completion of the work process, the e-portfolio can then be evaluated by the teachers both in terms of content aspects relating to the acquisition of competences and knowledge and in terms of general criteria. Such general criteria include appropriate scope, completeness, comprehensible and systematic structure, sound and factual accuracy, content and coherence (common thread, individual parts form a whole), originality, authentic and constructive reflection sections, formal criteria (artefacts have appropriate titles and references, bibliography, uniform font and font size, chosen layout etc.), linguistic formulations (grammar, spelling), sworn statement. In the chapter 3.2 on portfolios in the engineering sciences, it was also shown that the special engineering character of the e-portfolio can be implemented, in particular by adjusting the objectives, the competencies to be acquired and the evaluation criteria.

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The following results for the XP2P project were obtained from the basic literature work and the examination of the didactic requirements for an e-portfolio:

- A portfolio programme was selected in accordance with the didactic requirements described.
- A didactic concept was developed in the form of an example portfolio for the teachers and students involved in the project.
- Competences to be acquired in connection with portfolio work were defined and laid down in a competence framework for all those involved.

In the further course of the XP2P project, it will now be investigated how the practical implementation of the theoretical concept will look like. In particular, it must be considered whether the e-portfolio in its practical application has a positive influence on the peer-to-peer character of the project. Furthermore, it is important to determine whether the described benefits of such a time-consuming instrument as the e-portfolio are in a reasonable proportion.

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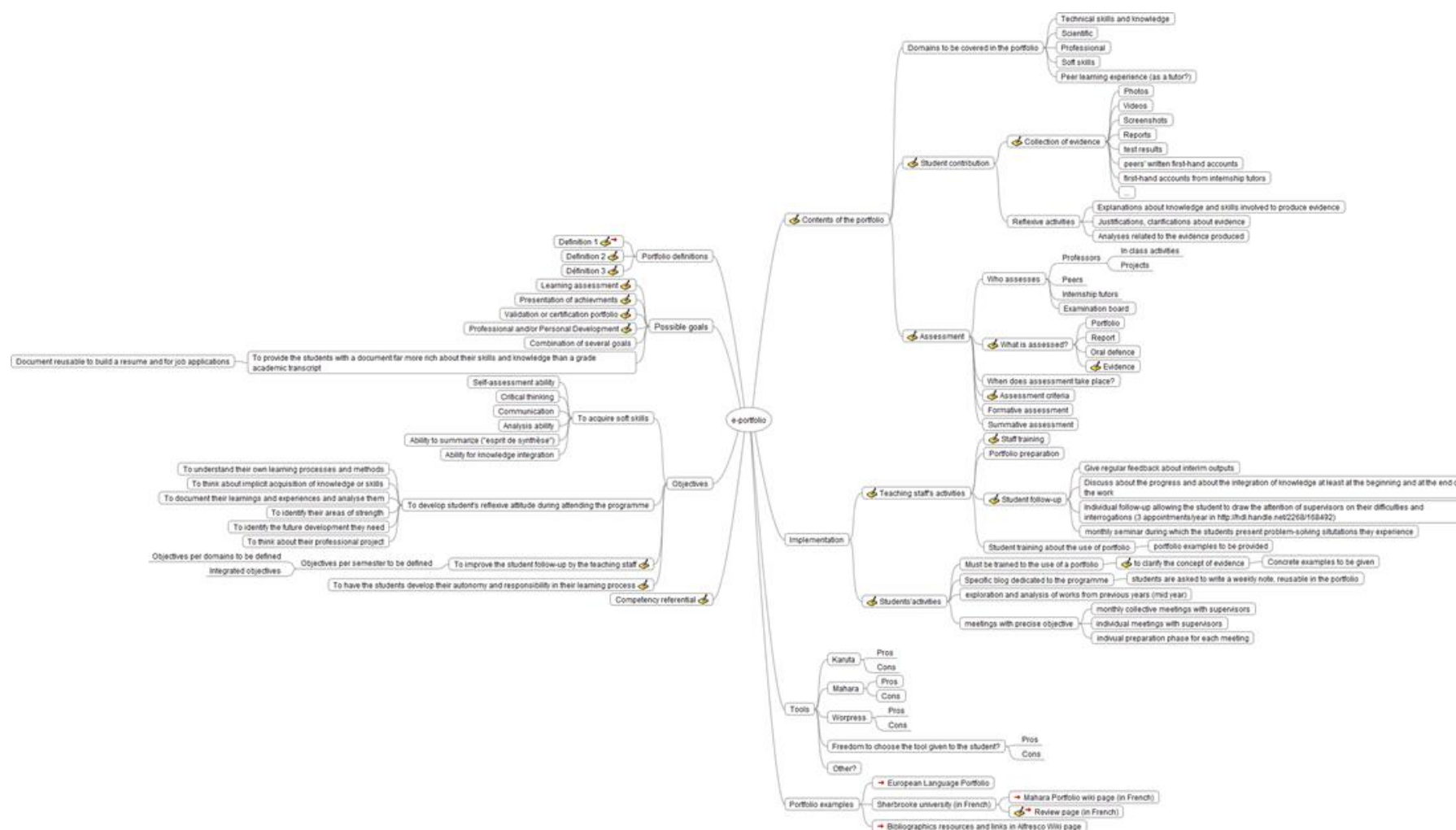
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8. Appendices

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Appendix 1: E-portfolio mindmap



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Appendix 2: Pedagogical engineering of e-portfolio course

Build the e-portfolio

Skills involved: autonomy, creativity, C 3.6, C 2.1

General objective: Promote, measure and value the development of its one's skills

Specific objectives	Teaching block	Activity nb	Skills worked on	Teaching methods					Job description	Learner activities	Estimated learner time	Resources	Type and description of the evaluation	Teacher activity	Design time	Animation time
				Presence	Distance	Conference	Exercise / experimentation	Project								
Engage in a reflective learning process by critically observing one's own learning, ambitions, strengths and weaknesses.	1. Competences	1	C3.6 Autonomy						Present a mind-map of another student's competences at M2 entry, justifying them.	Students work in pairs and independently. They have to discuss their career paths in order to identify the skills of their colleagues and present them in the form of a mind-map. Each skill must be proven. Students present the skills of their pair orally in front of the class.	3h	Evaluation grid	Formative peer evaluation: each pair must, in a concerted manner, ask at least one question and give at least one oral comment to the pair presenting the skills and at least one written comment to the teacher.	Creation of pairs. Creation of a mental map evaluation grid.	1h	3h

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Specific objectives	Teaching block	Activity nb	Skills worked on	Teaching methods					Job description	Learner activities	Estimated learner	Resources	Type and description of the evaluation	Teacher activity	Design time	Animation time
				Presence	Distance	Conference	Exercise / experimentation	Project								
Engage in a reflective learning process by critically observing one's own learning, ambitions, strengths and weaknesses	1. Competences	2	C 2.1 C 3.6 Autonomy						To present a mindmap of the skills developed during the Master's programme, during the course of training, on entry into M2.	Students must collectively build the Master's competency map, with the support of the teacher.	1h			Explanation of working instructions and facilitation of the collective session.		1h
	2. The e-portfolio	1	C 3.6 Autonomy						Make a presentation of the e-portfolio tool according to a plan given by the teacher.	Students must research and build a document presenting the e-portfolio tool and the approach based on it. They post their work on the EAD.	2h	Bibliography and sitography	Formative evaluation by the teacher (feedback).	The teacher writes the work guidelines and posts them on the EAD. He/she makes the necessary settings, particularly for the "Homework" activity in Moodle. He/she answers students' questions in person and remotely.	2h	5h

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				Presence	Distance	Conference	Exercise / experimentation	Project								
Engage in a reflective learning process by critically observing one's own learning, ambitions, strengths and weaknesses	2. The e-portfolio	2	C 2.1 C 3.6						Follow a presentation on the e-portfolio and a demonstration of the Mahara tool.	The students listen and watch the teacher's presentation on the device and the technical tool used to implement it. They try to understand and ask questions in order to do so. They exchange with the teacher and their peers.	1h30	Slideshow		The teacher builds a presentation on the e-portfolio and the Mahara tool. He/she makes a presentation in class.	3h	1h30

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Specific objectives	Teaching block	Activity nb	Skills worked on	Teaching methods					Job description	Learner activities	Estimated learner time	Resources	Type and description of the evaluation	Teacher activity	Design time	Animation time
				Presence	Distance	Conference	Exercise / experimentation	Project								
Engage in a reflective learning process by critically observing one's own learning, ambitions, strengths and weaknesses	2. The e-portfolio	3	C 3.6 Autonomy						Take control of your e-portfolio.	Students log on to Mahara and complete their profile. They adapt their dashboard and build a model of their tool.	1h30	Mahara Online User Manual	Peer Review in the form of online comments.	The teacher constructs an assessment grid and work instructions which he or she passes on to the students. He/she accompanies them in their activity and answers questions.	1h	1h30
	3. Newspaper	1	C 2.1 C 3.6 Autonomy Creativity						Fill in your logbook.	Students regularly fill in their logbook (once a week if possible) by looking back on their learning, their achievements and the acquisition of new skills.	1h/week	Sitography and bibliography Framework document. Mahara online manual.	Formative and peer evaluation, including feedback.	The teacher consults the articles put online by the students. He/she puts online the work instructions and the framework for the eportfolio.	1h30	30 min/week

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Specific objectives	Teaching block	Activity nb	Skills worked on	Teaching methods					Job description	Learner activities	Estimated learner time	Resources	Type and description of the evaluation	Teacher activity	Design time	Animation time
				Presence	Distance	Conference	Exercise / experimentation	Project								
Keep a chronological and thematic record of the activities undertaken during the year and their results (evidence).	4. Evidence	1	C 2.1 C 3.6 Autonomy						Download evidence of learning and skills acquisition.	Students upload on the platform all the documents that can attest to the acquisition of new skills (reports, group work, comments from teachers, tutors, peers, videos, TP, TD, etc.).	15 mn/week	The teacher writes and posts the work instructions online.			30 mn	

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Specific objectives	Teaching block	Activity nb	Skills worked on	Teaching methods					Job description	Learner activities	Estimated learner time	Resources	Type and description of the evaluation	Teacher activity	Design time	Animation time
				Presence	Distance	Conference	Exercise / experimentation	Project								
Selecting, organising and publishing evidence for presentation at a particular hearing.	5. Highlighting and proving one's skills, reflecting on one's learning.	1	C 2.1 C 3.6 Autonomy Creativity						Publish pages and collections by linking them with the skills developed within Master	Students regularly write and build pages and collections in a reflective learning process by presenting their most significant work proving their skills and linking it to their diary entries.	15 min/week	The teacher writes and posts the work instructions online.	Formative and peer evaluation in the form of feedback. Final summative evaluation during the oral presentation of the eportfolio by the students.	The teacher reads and comments on the pages and collections put online by the students. The teacher builds and uploads an evaluation grid and then evaluates the students' eportfolios following an oral presentation.	30 mn	30 min/week + 30 min per student

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Specific objectives	Teaching block	Activity nb	Skills worked on	Teaching methods					Job description	Learner activities	Estimated learner time	Resources	Type and description of the evaluation	Teacher activity	Design time	Animation time
				Presence	Distance	Conference	Exercise / experimentation	Project								
Assess and highlight your skills and readjust your objectives.	6. Assessing your skills	1	C 2.1 C 3.6 Autonomy						Self-assess yourself by completing the Master's competency grid.	Students publish the skills they acquire as they progress through their training course thanks to the Master's skills grid available on Mahara. They propose their self-assessment to their teacher.	5 min/week	The teacher writes and posts the work instructions online.	Self-evaluation of competences and validation by teachers.	The teacher validates and comments on the students' skills grids.	30 mn	15 min/week
		2	C 2.1 C 3.6 Autonomy						Self-evaluate yourself by publishing two mental maps.	Students build and publish a mental map presenting their skills at the beginning of the semester and one at the end of the semester.	1h	The teacher writes and posts the work instructions online.	Self-evaluation of competences and validation by teachers.	The teacher validates and comments on the student competence maps.	30 mn	3h

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Appendix 3: Master's skills in USMB (Master in Advanced Mechatronics)

Competence Nb	Competency	Component Nb	Component
C1	C1: Design and achieve a mechatronic system	C1.1	C1.1: By implementing an integrated process of multiphysics and multi-technology modeling, simulation and design
		C1.2	C1.2: By choosing, designing and implementing the required sensors
		C1.3	C1.3: By choosing, designing and implementing the required instrumentation
		C1.4	C1.4: By designing the mechanical and/or electromechanical architecture
		C1.5	C1.5: By choosing, designing and implementing the digital infrastructure present IN the system
		C1.6	C1.6: By choosing, designing and implementing the digital infrastructure present AROUND the system
		C1.7	C1.7: By implementing the lifecycle of the system or product
C2	C2: Manage a research project	C2.1	C2.1: By organizing his/her activity and the activity of his/her team
		C2.2	C2.2: By reporting to the research program manager
		C2.3	C2.3: By considering the questions of eco-responsibility of his/her projects and their legal and economic consequences
C3	C3: Master the skills required for research activities	C3.1	C3.1: By managing scientific knowledge
		C3.2	C3.2: By spreading scientific knowledge
		C3.3	C3.3: By applying the principles of professional ethics
		C3.4	C3.4: By knowing how Research is organized and funded
		C3.5	C3.5: By understanding the issues of intellectual property
		C3.6	C3.6: By working in an international environment
		C3.7	C3.7: By managing uncertainty and challenges

Skill acquisition levels of the Master AM in USMB

- Beginner: has shown commitment to the expected task but is not able to put in practice the concerned knowledge or skills
- Intermediate: has shown commitment to the expected task and is able to put in practice the concerned knowledge and skills in simple or known situations
- Advanced: has shown commitment to the expected task, is able to put in practice the concerned knowledge and skills, without help, in usual situations
- Master: has shown commitment to the expected task, is able to put in practice the concerned knowledge and skills, without help, and is able to propose pertinent solutions in various situations.

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