Competence Development through Assessment

A BOOST! pilot on assessment as learning in CBL education with support of a digital platform

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1. Introduction

Education at TU/e is increasingly organized around a defined set of competencies of relevance for different domains or professional profiles. Challenge-based learning (CBL) is an educational concept that aims at fostering the development of academic competencies (within the student's knowledge domain) but also generic competencies relevant for success in professional life. Examples of these broader competencies are the ability to communicate in interdisciplinary teams, to manage projects, and to reflect.

With this proposal, we aimed to run a pilot within the challenge-based initiative innovation Space Bachelor End Project (ISBEP), to allow students (and educators) to assess and support the development of these generic professional competencies. The goal was to provide more timely insight and feedback to students regarding their development on these competencies; to empower students to (self)direct their learning throughout projects.

We implemented and tested a digital platform for that matter, which gives learners visual insight (e.g., graphs depicting growth) in their competences development, and allows for low-threshold feedback from (ISBEP) process coaches, academic supervisors, and external experts. We aimed to better understand the platform's effect on competency development and learning and to collect insight to improve the support of the student learning process through assessment. For example, on whether students achieved meaningful feedback, and the aspects that helped them make decisions regarding the development of their competences. Moreover, we aim to understand the platform's value for educators, e.g., on whether it helps them provide more targeted and timely feedback or assess the overall (summative) development of students.

2. Context of the project: The innovation Space Bachelor End Project

The innovation Space Bachelor End Project (ISBEP) is an interdisciplinary, inter-program learning experience coordinated and organized by TU/e innovation Space. As ISBEP is a small-scale project that is repeated in February and September of each year, it provided a good setup to follow the experiences of students with the platform closely.

One of the key features of ISBEP is that students work on real world, open-ended challenges. These challenges are intentionally ill-defined, with no clear set of goals/outcomes. The process and steps to be followed are project-dependent and student-led: Students dedicate the first weeks of the project to explore the challenges and identify their problems to focus on.

Another characteristic of ISBEP is the larger number of stakeholders involved in the learning experience and competence development support of students. Figure 1 presents an overview. Students team up with peers from different programs to form an interdisciplinary team. As a team, they work on a challenge brought-in by a challenge owner, who provides feedback on the solution and project direction, but also on the professional attitude of students. Moreover, teams are coached by ISBEP coaches on aspects related to the interdisciplinary project, and related competencies (i.e., interdisciplinary communication). Furthermore, each student is assigned an academic coach (i.e., supervisor), who overlooks student development in content knowledge and

conducts the (individual) summative assessment. ISBEP is a high-stakes project where students are awarded their bachelor diploma upon satisfactory completion of the project. Table 1 provides a detailed description of all stakeholders and their connection to (formative) assessment. An overview of the final (i.e., improved) assessment setup of ISBEP can be found in Section 2.2.
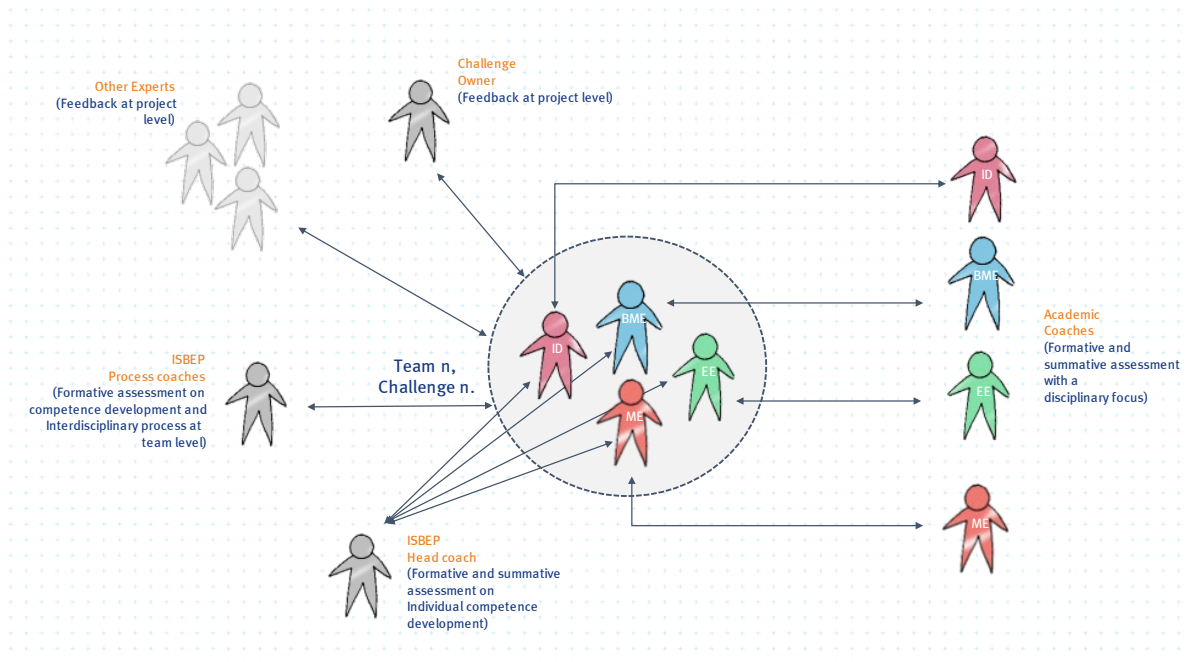

Figure 1. Learning unit of ISBEP students and stakeholders supporting their learning

2.1. Challenges in Assessment in CBL

Since 2019, ISBEP has been an environment in which research on assessment was conducted. Earlier work in literature had already indicated issues regarding assessment in general (Boud & Falchikov, 2007; Nilson, 2015), as well as specifically in CBL (Santos et al., 2020; Valencia et al., 2020). Three of those issues are of key relevance to this project:

i.   Perceived lack of clarity about assessment criteria and procedures within CBL. This is motivated by the substantial number of stakeholders participating in the projects, such as process coaches, academic supervisors, who might have varying criteria for assessment, and play separate roles in the assessing procedures.

ii. Perceived discrepancy between learning outcomes and assessment criteria/procedures. Assessment continues to be more output-based and focused on disciplinary knowledge. However, through CBL students develop broader professional skills, such as interdisciplinary communication. The development of competences calls for formative approaches along the process (instead of at project completion, only), so that students can align their learning strategies timely.

iii. The need for academic coaches to adapt assessment procedures and practices to fit the needs of students. Academic coaches, who oversee the summative assessment of students, lack process-related information (i.e., interdisciplinary projects), which can be used as input for the summative assessment of students.

Table 1. Detailed description of stakeholders involved in ISBEP and their relation to (formative) assessment

Stakeholders	Definition and connection to (formative) assessment
Students in the student team	Students from different disciplines. Help in the reflection process by providing feedback on competence development and/or performance. Peers in the team are also a channel to develop competences, particularly those well connected to peer learning, such as collaboration and communication.
Process coach	Senior students (ISBEP alumni) participate as process coaches, overseeing the interdisciplinary collaboration and team dynamics. The process provides guidance on aspects, such as communications/collaboration with challenge owners and cohesion within the team. Furthermore, they keep track of the overall development of students and their competence development, providing feedback on how to improve. They are a first contact point in case of personal struggles, and a direct link to the head coach.
Head coach	Works closely together with process coaches to oversee the overall development of ISBEP students at individual and team level. Is responsible for the intermediate and summative evaluation of student's competences development. Provides one-to-one feedback to students twice in the semester and on demand. Is responsible for planning and organizing other activities of relevance for the competence development of students, such as workshops/training, and feedback moments with key stakeholders, such as challenge owners. In the link to the different programs and oversees the alignment in terms of assessment with the different departments (e.g., through the academic supervisor).
Academic Supervisor	Responsible for overseeing the development of the individual students and their project from a program/disciplinary perspective. Provides coaching and feedback on content-knowledge relevant to achieving the goals related to the interdisciplinary project. Responsible for assessing the quality of the final product (individual contribution; together with examination committees), following program-specific rules/regulations/criteria.
Challenge Owner	Provides the challenge that students work on with the interdisciplinary team. Provide feedback at team level on project direction/development. Connects to other experts/parties in their network of relevance to the interdisciplinary project.
Experts	Not accounted for in the planning of the learning experience as they vary from project to project/student. They provide expert advice/feedback on specific knowledge/skills needed for the project's completion. Often connected to students/teams via challenge owners or academic supervisors.

3. Goal and objectives

Considering the challenges that CBL assessment poses to CBL practitioners (Section 1.2), our main goal is studying the impact of the implementation of a learning management system to support students' learning through assessment in the ISBEP context; and to translate collected into a set of functional requirements that capture the needs of students and teachers. To this end, the following objectives were established:

- Run a pilot within the challenge-based initiative innovation Space Bachelor End Project (ISBEP), to allow students (and educators) to assess and support the development of generic professional competencies.
- (Re)design the assessment as learning design in ISBEP with the aim to provide more timely insight and feedback to students regarding their development of these competencies to empower them to self-direct their learning throughout projects.
- Implement and test a digital platform that supports assessment as learning, which can give learners visual insight (e.g., graphs depicting growth) into their competence development and allows for low-threshold feedback from (ISBEP) process coaches, academic supervisors, and external experts.

- Gather best practices regarding competence development assessment supported by a learning management system.
- Gather insights on design features associated with the learning management system interface.
- Understand this platform's value for educators, e.g., whether it helps them provide more targeted and timely feedback or assess the overall (summative) development of students.

4. Project Phases and Results

Four phases have been defined for the project, which are linked to our objectives (see Figure 2). Information on methods, procedures and results is reported, per phase, below.
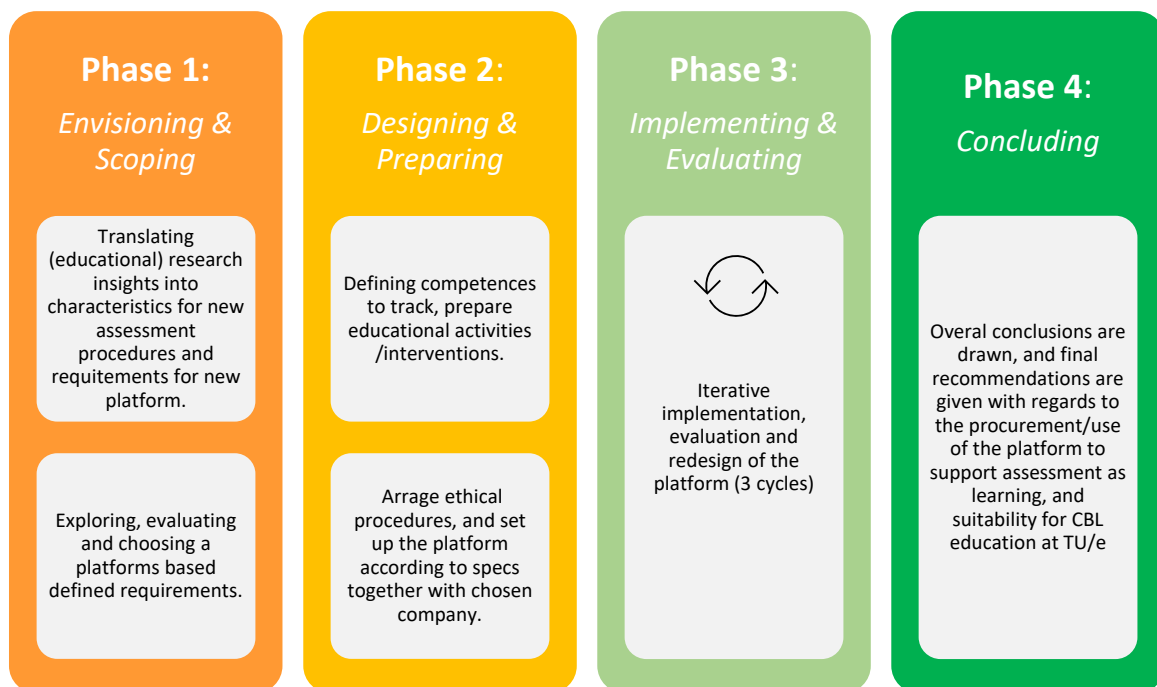
Phase 1: *Envisioning & Scoping*	Phase 2: *Designing & Preparing*	Phase 3: *Implementing & Evaluating*	Phase 4: *Concluding*
Translating (educational) research insights into characteristics for new assessment procedures and requitements for new platform.	Defining competences to track, prepare educational activities /interventions.	Iterative implementation, evaluation and redesign of the platform (3 cycles)	Overal conclusions are drawn, and final recommendations are given with regards to the procurement/use of the platform to support assessment as learning, and suitability for CBL education at TU/e
Exploring, evaluating and choosing a platforms based defined requirements.	Arrage ethical procedures, and set up the platform according to specs together with chosen company.		

Figure 2. Illustration of the four phases that were defined in the project

4.1. Phase 1: Envisioning & Scoping

In this phase, the vision for assessment as learning in ISBEP was defined, and a digital platform that supports that vision was selected. Insights from educational design research (Valencia et al., 2020; Valencia et al., 2021) were translated into a set of characteristics for new assessment procedures, leading to the definition of requirements for the new digital platform (the revised and final list of requirements can be found in Appendix C).

Regarding the characteristics of assessment, self-assessment, peer-learning, reflection, and coach feedback, were defined as the pillars of the new assessment setup, as together, these methods can stimulate self-awareness and help students self-direct the development of their competences (van der Vleuten et al., 2017). Regarding the requirements of the platform, these have been detailed and captured in a list of functional and non-functional requirements. Examples of functional requirements include the possibility to setup personal development plans, the support of different assessment methods and forms (i.e., self-assessment, 360o assessment), and the possibility to

monitor the development of students via dashboards and graphs. Examples of non-functional requirements include the after sales support of the provider, security measures/data privacy measures in place, and the possibility to train TU/e staff on the use of the tool.

Together, this information was used to create a vision on assessment as learning for ISBEP, translated in a series of images (See Figure 3 for a sample of these images) used for communication purposes within the project's team (i.e., aligning on ideas, expectations). These images also guided the search for a platform and aided in the communication towards vendors.
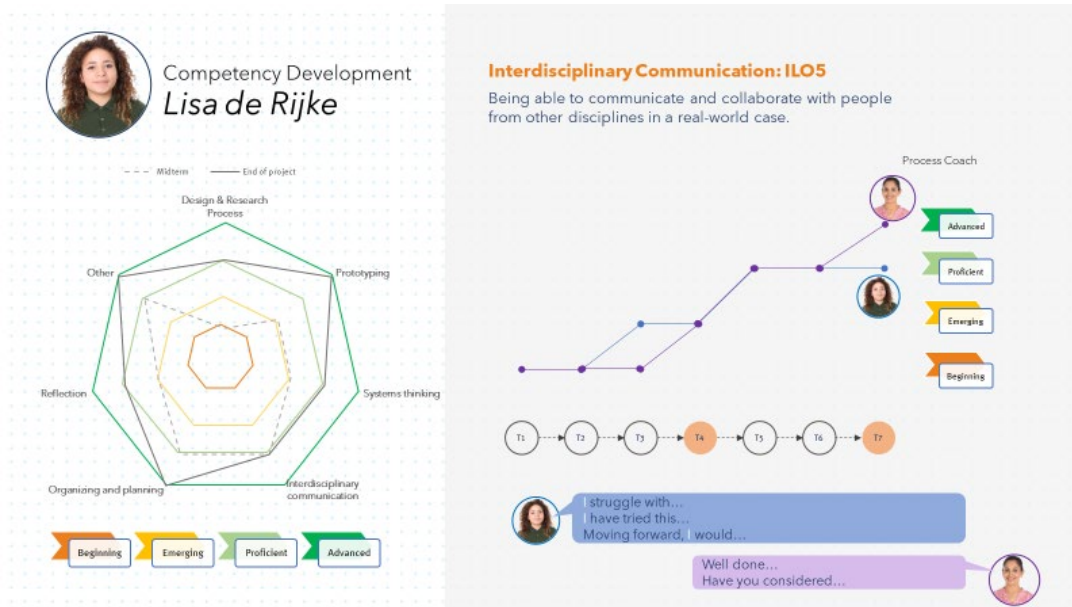

Figure 3. Illustration of vision on assessment as learning for ISBEP including functional requirements

The exploration and evaluation of platforms took place between March and August 2021. The market exploration was guided by state of art information at the time on e-portfolios (Ham & Elk, 2018), as well recommendations/references from practitioners. Based on this first scan, three tools were selected as possible candidates because they appear to align well with our vision on assessment and requirements. These companies (i.e., FeedPulse, Scorion, EPASS), were approached separately, demos were arranged to discuss the vision on assessment as learning and evaluated against our list of functional and non-functional requirements. Based on this, Scorion (https://scorion.nl/) was selected as the tool to support assessment as learning in ISBEP. Scorion demonstrated to be a stronger contestant in terms of the functional and non-functional requirements. Among these, the flexibility shown for development, security and certification of the tool and processes, flexibility for configuration by users, and the contextual situation, Scorion was the preferred platform of the evaluated candidates to achieve our goals in competency development through assessment for ISBEP.

4.2. Phase 2: Designing & Preparing

Phase 2 focused on detailing the design for assessment as learning, including the definition of competences to be supported by the digital tool. Moreover, the design of assessment as learning was further elaborated in relation to the digital tool, resulting in a combination of interrelated in-class and platform-based activities to be implemented:

Assessment as Learning in ISBEP with the support of a digital platform

As described in Section 1.1, students follow two parallel assessment procedures: One with their respective (individual) academic coach (who oversees the summative assessment in relation to the disciplinary development), and one in the context of the interdisciplinary project. For this pilot, it has been decided to center the efforts with the digital tool around the latter.

Assessment within ISBEP is focused on students personal and professional development and centered on the learning taking place through the interdisciplinary collaboration and open-ended challenge. Six competences are supported in ISBEP and associated to seven different Intended Learning Outcomes (ILO's), which are listed in Table 2 below.

Table 2. Competencies supported in ISBEP and associated ILO's

	Competence		ILO (Intended Learning Outcome)
Relation to Others	**Design & Research Process**	1	Identify the needs of different stakeholders and integrate them in the viable solution.
		2	Identify the interdisciplinary problem that needs to be solved within the challenge, and the individual contributions/ projects (i.e., disciplinary components).
	Envisioning	3	Translate the individual components (i.e., individual contributions) into an integrated working / experiential solution.
	Systems thinking	4	Demonstrate the ability to approach the project with a holistic perspective, by clearly denoting the interrelations between individual contributions and their boundaries.
	Interdisciplinary collaboration	5	Being able to communicate and collaborate with people from other disciplines and apply in a real-world case.
Relation to Self	**Dealing with uncertainty**	6	Manage a situation where there is no clear answer to their problem.
	Reflection on learning	7	Reflect on their role in the interdisciplinary team and its impact on professional identity.

Assessment with ISBEP is both formative and summative and aimed at supporting the competence development of students. To this end, the development within the respective ILO's has been further detailed in four developmental levels, ranging from beginner to advanced, which are indicative to the level of independence of the student (i.e., self-directed learning) in the development of their competences. These competences, levels, and respective performance indicators have been captured in the ISBEP Development Guide; a tool developed to support students in better understanding their development on competences within the project (See Appendix A). This tool is also the basis for the several (formative) assessment activities in ISBEP.

Regarding the interrelation of assessment as learning activities, we have set up an iterative reflection cycle (assessment as learning/programmatic approach, van der Vleuten et al., 2017), and tightly linked to the pilar assessment activities: Self-assessment, peer-learning, reflection, and coach feedback (Figure 4).

The reflection cycle takes place along seven T-moments (T0-T6). At T0, the departing point for students and coaches, students review the competences and ILOs defined for ISBEP, and specify personal learning goals. These personal ILOs (P-ILOs) are documented in the digital platform with the intention to help coaches maintain the overview of students and provide targeted feedback to

students. From T1 onwards, students then self-assess and reflect on their overall personal and professional development (through conversations with peers and coaches), and following guiding questions (See Appendix B).
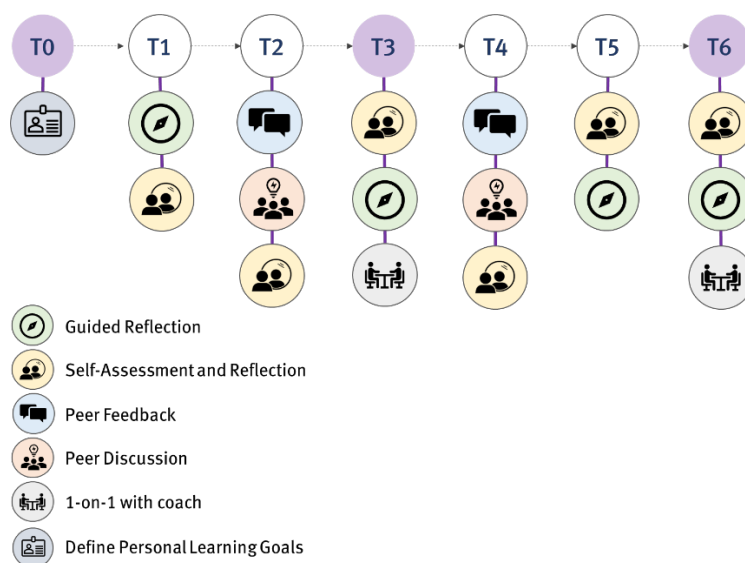

Figure 4. Iterative reflection cycle in ISBEP

Students' self-assessments and reflections on learning are monitored and validated by the ISBEP coach. After each self-assessment & reflection moment (T1-T8), students send this information to their process coach for review. Students' process coach provides further feedback on this self-assessment/reflection, and a new reflection cycle is initiated. At three points in time, we pay special attention to their reflection:

- At T0: At the start of the project to understand students' development goals and how they use ISBEP as a means for learning.

- At T3: Halfway through the project, to be able to provide key feedback and help students define strategies to improve learning, when needed. There will be one-on-one sessions with the teacher responsible for the course to discuss students' personal development.

- At T6: At the end of the project, obtain a picture of your overall learning. There will be one-on-one sessions with the teacher responsible for the course to discuss students' personal development.

At the end of the project, students' overall development within ISBEP is discussed, based on the observations/feedback from process coaches, and evidence (e.g., reflections) presented by them. In consultation with the head and process coaches of ISBEP, a pass/fail for ISBEP is granted.

Assessment of students' individual BEP (Bachelor End Project) is performed by their academic coach, and in some departments, students will have to defend their work in front of a committee. In addition, the Professional Skills that are attached to students' departmental BEP will be assessed according to the rules and regulations that apply within their own department. This brings the challenge of combining students' efforts for the ISBEP group with those needed for their own final bachelor's project. Students' academic coaches are aware of this challenge, and they will be available to discuss with them what exactly they expect from students in this project.

Throughout this process, the digital platform is used as a tool to support the assessment as learning set up (See Appendix C for impressions of the look and feel of the platform). Table 3 provides an overview of stakeholders in ISBEP and summarizes the types of interactions they have with the

platform. Note that for the current pilot the main beneficiaries are students and ISBEP coaches. This is a design choice, however, due to the limitations of the pilot. In the future, this set up could be expanded to support other stakeholders, such as academic supervisors, to strengthen the assessment as learning setup.

Table 3. Overview of stakeholders and their interaction with the digital platform

Stakeholders	Interaction with the platform?	Type of Interaction
Students in the student team	Yes	Documenting personal ILOs Self-assessment based on ISBEP rubric Reflection on learning Collecting feedback from peers Collecting feedback from other relevant stakeholders (challenge owner, experts) Access to dashboards and line graphs Exporting summary reports to share with others (.doc, .pdf)
Process coach	Yes	Validation of self-assessment by students Narrative feedback on competence development and learning Overview of students, teams, and form status (i.e., at which T moment students are at) Overview of dashboards and development graphs per student
Head coach	Yes	Validation of self-assessment by students Narrative feedback on competence development and learning Overview of students, teams **and** cohort, and form status (i.e., at which T moment students are at) Overview of dashboards and development graphs per student
Academic Supervisor	No	Not by design. Possible if requested by student
Challenge Owner	Possible, not compulsory	Only when students choose to request formative (narrative) feedback
Experts	Possible, not compulsory	Only when students choose to request formative (narrative) feedback

4.3. Phase 3: Implementing & Evaluating

In Phase 3 the assessment as learning set-up and digital platform were implemented, evaluated, and redesigned in an iterative process lasting three full semesters. Overall, we experienced the digital tool as supporting the competence development of ISBEP students. Figure 5 below shows the average self-reported levels on each of the ILOs throughout the course for all students in the 2023 spring semester.
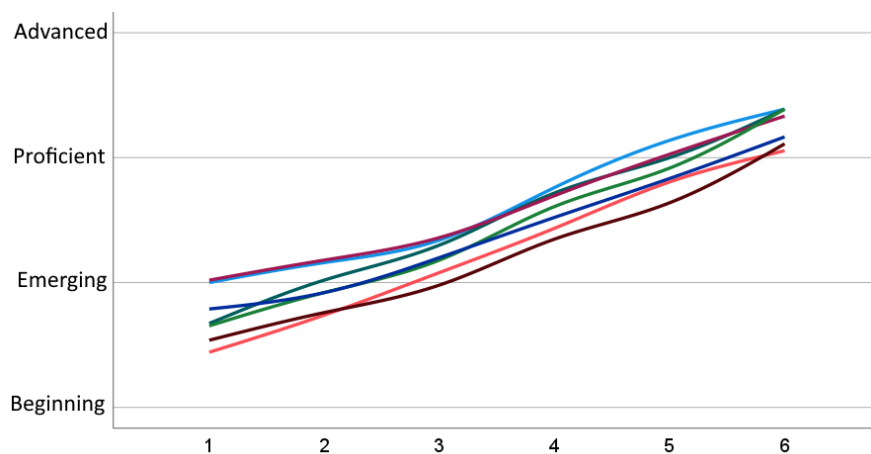

Figure 5. Overview of self-reported growth on competencies throughout the course
(six different time moments shown on the horizontal axis)

Methods

Evaluations of the assessment as learning setup and digital platform followed a mix methods approach, including in-depth group interviews with students and coaches, ad-hoc contextual inquiry, and plenary discussions with students with the support of the educational tool Mentimeter (Table 4). Evaluation covered aspects related to the user friendliness of the platform but also its overall value for education/learning. The two most important topics that were addressed are whether the platform stimulates self-directed learning and competence development, and whether the platform supports assessment as learning. However, other aspects, such as the usability and accessibility of the tool were addressed too.

Regarding the group interviews, these were conducted with students and process coaches. Several semi-structured, in-depth interviews were done throughout the three semesters the pilot took place. Interviews were conducted at separate times of the student's project and therefore the nature of the interaction of students with the digital platform. Regarding the plenary sessions with Mentimeter, these were set-up for the second and third semester that the pilot took place. Two sessions were scheduled per semester: at the beginning of the ISBEP project, and at the end of it. The students were requested to evaluate their level of agreement or disagreement with several statements associated with their experience with Scorion (7-point Likert Scale, strongly disagree to strongly agree). The aggregated answers to each of these questions were displayed in real time on a big screen, which all students could see. Each question and answer would be followed by a plenary discussion where students could substantiate their answers. The questions used in this activity were adapted each semester to fine-tune the instrument. (See Table 4 for an overview of the last version of the questions).

For all interviews and plenary discussions, intelligent verbatim transcription was implemented each semester. These data were analyzed by an educational researcher, identifying themes and topics, and discussed with the innovation team to identify relevant changes in the assessment setup and digital tool.

Results of the evaluations

We organized general results of this pilot under the following themes: *didactic component, platform-specific insights (e.g., functionality), and general insights*. Next to this, the statements and average mark given to them by students on the Mentimeter surveys are indicated in Table 4. Our findings regarding the themes and the Mentimeter results are expanded below.

Table 4. Students' evaluation of Scorion

Scorion - Students' Evaluation				
Statement	Eval.Q1 22-23	Eval.Q2 22-23	Eval.Q3 22-23	Eval.Q4 22-23
	Responses=17	Responses=14	Responses=33	Responses=33
I understand the purpose of Scorion	4.7	4.9	5.2	5.2
Scorion supports my learning process	3.3	3.4	4.3	3.4
Scorion helps me keep track of my learning goals	3.9	5.3	5.5	4.3
Scorion facilitates my reflection process	3.8	4.3	4.8	4.3
Scorion helps me improve my day-to-day learning within ISBEP	1.8	1.9	2.3	2.7
Scorion helps me keep track of my overall learning and competence development	4.4	4.8	4.9	3.6
Scorion supports my communication with my process (ISBEP) coaches.	3	2.6	2.9	3.3
Scorion enables me to identify important topics to discuss with my coaches	1.4	3.1	1.9	3.0
Scorion supports me in reflecting about my role and contribution to the team	-	-	3.7	3.7
Scorion enables me to identify important topics to discuss with my teammates	-	2.3	2	3
Scorion is easy to use	5	4.6	4.1	4.3
Scorion support my communication with my team mates	-	1.7	-	-
I use Scorion to collect challenges owners' feedback regarding the ISBEP learning goals	-	1	-	-

i. *Didactic components*

The students indicated in their feedback that they understand the purpose of Scorion, and this purpose becomes more evident throughout the development of the ISBEP project. Students manifested that Scorion helps them make explicit and clear their learning goals, and it provides a clear picture of what they need to achieve at the end of their participation in ISBEP. In addition, students indicated that they perceived the value of Scorion when they analyzed their competence and skill development over the long term. On the other hand, they explicitly manifested that Scorion didn't help them analyze their competence and skill development on a daily basis because it is their belief that the competences develop slowly through the semester.

Regarding the reflection process, students indicated that Scorion helped them organize the ideas to perform reflections on their development and performance in the team. They indicated that having a tool to store and organize their learning goals and reflections positively impacted their perception of the learning process they experienced during their participation in ISBEP. In addition, it is relevant to notice that the phrasing of reflection questions strongly influenced students' responses, so carefully constructing these questions is key for reaching appropriate levels of reflection (Wallin & Adawi, 2019).

On the other hand, the major weakness that students identified is that Scorion does not provide them with a clear idea about the steps they have to take to move from one level of proficiency to the next. In addition, some students indicated that the way ILOs are phrased is vague and difficult to clearly understand. Finally, they indicated that some of the levels of proficiency seemed to overlap. In that regard, it is relevant to remark that the rubric that we designed focused heavily on *process*, which facilitates reflection and shows where there's room for improvement and how to get there. It should be noted, though, that students felt that they could only be evaluated on their *shown* behavior and not on the abilities they thought they possessed. This situation highlights the relevance of phrasing the various parts of the instruments carefully to make them clear enough for them.

During the meeting with the coaches several insights were gathered, they are described below:

Coaches reported that they perceived that Scorion helps students realize where they are located in the learning process during the ISBEP experience. The reported impact is associated with the increased ease with which students can keep track of their development, which is facilitated by the Scorion interface. In this interface, Scorion allows students to observe the level of development of the ILO's. However, coaches reported that students have difficulties figuring out strategies to move from one level of performance to the next. In this regard, the activities organized by the teaching staff allow students to visualize the strategies to move from one level to the next.

With respect to the personal ILO's, the coaches indicated that students are allowed to change them through the development of the project. The reason for that is substantiated by the difficulties students have in visualizing how to achieve their personal ILOs at the beginning of the semester. As the semester passes, the students increase their awareness of what they can and want to achieve. However, coaches face difficulties when trying to follow up on the changes introduced by students. Nowadays, the system does not inform coaches when a change is introduced. For the coach, keeping track of it without the help of a Scorion function is too demanding in terms of time. In addition, coaches report that Scorion has more impact on individual reflections than on team reflections.

Finally, based on the experience we acquired during Scorion implementation, we noticed that the balance between the three components of constructive alignment (e.g., Biggs et al., 2022) must be evaluated iteratively, as well as how the platform supports us in achieving this alignment.

ii. Platform-specific (e.g., functionality)

The student's opinion about the Scorion platform interface is positive. Students indicate that the design of the platform fits the purpose and allows them to navigate through the different menus with ease. In addition, students expressed that the graphical interface of Scorion allows them to keep track of their competence and skill development in a straightforward way. However, they manifested that there are some features that can be improved. Two topics that were mentioned consistently were the following: the students' suggestion to integrate in Scorion the capability to send forms in parallel to two or more team members when asking for feedback from peers; and making the function to save and send a form more intuitive. This has been registered repeatedly through the Mentimeter surveys, interviews, and focus groups, and it is considered a negative feature that affects the evaluation of Scorion's ease of use. However, it is not possible to change this because it implies a major change in the software structure.

Also associated with the user interface, students manifested that when completing self-assessments, they did not see their scores on previous assessments. Therefore, showing past assessments during each new assessment is needed to allow students to reflect better on their learning. In similar ways, the dashboard of the platform did not increase students' awareness of their competence development in the way we expected.

Also, in line with the user interface features, the coaches indicated that some features associated with the Scorion interface could be improved. Some of those are the layout and the sentence written on the save and send button, which also generated some confusion for students.

Based on the current coaches' experience during this implementation, it was detected that it is not possible for them to have an overview of earlier assessments. It would be desirable to provide the system with the capacity for the coaches to see that information and bring it along to the coaching sessions. It could potentially increase the coaching sessions' effectiveness.

Finally, we would like to remark that one of the most relevant results we observed in this implementation is that the platform is not a one-size-fits-all solution. Depending on the context of implementation, the platform can be used in diverse ways, but the most relevant element is using it as a facilitator for achieving constructive alignment during the learning experiences provided to students.

iii. General insights

Communication-wise, students indicated that Scorion does not support their communications with other team members. They mentioned that email, WhatsApp, and live meetings are more useful and efficient when communicating with them. It is related to the fact that using Scorion as communication support implies opening the computer and entering the platform, which requires additional time to send a message. On the other hand, the other means mentioned above allow students to send and receive messages in a shorter and easier way.

Regarding the communication with the teaching staff, they indicated that Scorion generates the space to store the feedback that is provided by them. However, live meetings and the Miro board also play a relevant role in this type of communication.

During quartile three in the second semester, 22–23, a new feature was integrated: peer feedback. The activity included a first phase in which students selected teammates to provide feedback. The feedback was provided through the Scorion platform. In the second phase, a live conversation about the feedback was facilitated by the process coaches. Two rounds of interviews with team members were carried out, and the most relevant outcomes are described in the next paragraph.

Students manifested that this new feature stimulates reflection and adds value because it allows integration on one platform and avoids post-processing the information gathered from peers. In addition, students think that this way of providing feedback allows them to keep track of the feedback they receive. In addition, providing feedback through the platform allows a person to avoid providing feedback during the "heat of the discussion." On the other hand, students perceive that defining specific points in the feedback content is difficult. To overcome this, students propose to provide some examples of feedback to have a clear view of what is expected by the teaching staff.

In addition, students indicate that in the initial stages of the process they struggle to visualize the value that this feature can add to their competence development process given the limited interaction they had with their teammates.

Other points that were highlighted by students as relevant to them were: user experience and the value perceived for their personal development. Regarding the user experience, they suggested improving the interface to make it more intuitive. They indicated that the current design has some room for improvement regarding the labels of the buttons; now they are not clear enough. Also, they suggested including the possibility of sending two peer feedback forms in parallel to make this process more efficient.

Finally, students reported that they perceived peer feedback as a value-added activity. They informed that feedback helps them visualize their improvement opportunities to achieve the expected ILO's. Also, they indicated that the Scorion peer feedback feature is good for capturing in an organized way the feedback from peers and also helps them increase their awareness of the topics to be discussed in the live feedback meeting. They manifested that the live meeting had a profound impact on their awareness, and Scorion's feedback features are a good complement for that.

Regarding the help Scorion provides to coaches to validate the marks, they mentioned that Scorion helps make the process faster. It also makes the process more scalable. In this process, Scorion allows coaches to have a digital file that they use to prepare and mirror the conversation they have with students. They declare that without this feature, this process would take more time and be more difficult.

Another relevant result is the close collaboration between researchers, teachers, and IT (Information Technology) experts. In this implementation, the team learned that it is difficult to figure out every detail in advance; therefore, having the capacity to implement fast changes in an iterative way is relevant to keeping innovating during the implementation process.

Finally, we noticed that this way of recurrent assessment is new for students, even though they are reaching the end of their program. We therefore think it would be helpful to provide students with experiences with this form of assessment early in their program, as it may increase the gains in competence development. Finally, the platform allows us to monitor the development of students and manage the differences between students in a team, aiding the coaching process, and helping students develop individually and as a team through the project.

5. Conclusions and recommendations for practice

With this project, we set out to design an assessment as learning approach for ISBEP students, aimed at supporting competence development. Our motivation stemmed from past educational research on ISBEP and broader, which pointed to key challenges on assessment in CBL. These challenges included: the perceived lack of clarity about assessment criteria and procedures within CBL, the perceived discrepancy between learning outcomes and assessment criteria/procedures, and the lack of process-related information that could inform the overall assessment of students (including the disciplinary aspects). Our overall goal was to tackle these challenges, while supporting competence development and learning, using a digital platform.

Overall, we can conclude that the platform can be an effective instrument to support assessment as learning and self-directed learning. This is evidenced on various student's and coaches 'evaluations, particularly in relation to how the platform helps these two groups keep track of learning goals, facilitate reflections on learning, and keep track of their overall competencies' development.

In the case of ISBEP, the platform played little role in supporting day-to-day decisions and discussions around the process or project, or identifying key topics students would like to discuss with their teammates. This is not a consequence of the platform itself as the main reason for this was the design of the questions, which were aimed at eliciting personal insights on development and competence development (e.g., challenges, strategies, next actions). Evaluations with students indicated that they value overall the emphasis on long-term learning and development of the platform. Other topics are addressed through other means and in other places (i.e., MS Teams, Whatsapp, during team meetings).

Similarly, other uses such as communication between peers, and communication between students and coaches do not appear to have value in this context. For ISBEP, students prefer other means of communication, such as verbal, or email, particularly when it relates to topics such as feedback. The platform was appreciated as a means to get insight and collect input for discussion, but students rejected the idea of replacing real-life conversations altogether for interactions through the platform.

Dashboards are seen as valuable, particularly those on monitoring Intended Learning Outcomes (ILOs) and Personal Learning Goals (PLGs). Dashboard at competence level were not seen as relevant in this context as it does not provide relevant information for the learning gains in one semester. Importantly, dashboards should be easily accessible and easy to understand for students. This goes together with having a clear user interface and UX. In our case, the UX was not a strong asset (it was not our focus to improve it during the limited course of the pilot) which created confusion at times and made it difficult for students and coaches to find certain functionalities.

For coaches, the digital platform was seen as valuable in diverse ways. First, the tool allowed coaches to access in-depth information regarding student's learning easily (individual level), and over time. The tool helped coaches be informed for coaching sessions, and to provide timely feedback on key aspects of development and beyond (e.g., personal struggles). Second, the digital platform streamlined the assessment process for coaches, allowing them to combine diverse ways of collecting information, through different forms, such as self-assessment and reflections. This proved to have a high impact, particularly in comparison with the previous situation, where information was gathered from different sources (e.g., email, MS Teams) and the organization and management of the data resulted in considerable workload for the coaches. And third, it was valuable to have a secure data-driven system in place that collects feedback for individual students in a systematic way. Having a trust-worthy and certified platform is important for sharing personal struggles and reflections with coaches, as it commonly concerns privacy-sensitive information. Maintaining

confidentiality of the information is necessary to gain trust and allow open reflection between coach and student.

A prerequisite for successful implementation of such a tool in a challenge-based learning course, is that the course has a clearly designed educational approach in place, where the students are guided in their process and in using the platform to support their development. Scorion has options to support a range of approaches, but does not replace the need for a teacher to design an approach to assessment-as-learning and individual and team reflection. Also, during the editions of ISBEP that this pilot took place, we have made substantial changes in the way we communicated with the students, the questions and rubrics used, and the interplay between in-class activities vs. reflection in the platform.

In summary, the tool was seen as valuable but not in itself. Students consistently evaluated the tool in connection to other in-class activities, such as the facilitated (team) reflection session and the coaching sessions. The tool is valuable as an add-on to the assessment as learning set up but should not be considered an 'all fixer' for assessment and competence development. Key attention must be given to the vision on assessment (for the module or curriculum), which will determine, in turn, the purpose and use of the tool.

6. Limitations of the project and possible next steps

Our pilot faced several limitations, as it was implemented in the specific context of ISBEP, tailored to the needs for each edition of the course, and based on the insights gained. First, we set out to explore competence development at an individual level in this pilot. However, collaborative teamwork (e.g., multi, inter, and transdisciplinary) is an important aspect of CBL. Exploring how competence development might be supported in the context of a team could be valuable to our further understanding of assessment as learning and competence development as supported by a platform. For example, functionality on team aspects, such as communication, collaboration, as well as group-related dashboards, were not implemented in the current pilot as they required additional development steps for Scorion (nor was it within the scope of this project). Future pilots are needed to investigate the interplay between individual and team (competence) development as these are important aspects of Challenge Based Learning.

Second, self-directed learning as a competence is developed and supported in diverse ways at TU/e. It has been our experience that students from different programs arrive at ISBEP with significant varying levels of self-directed learning. Because of this, we opted for a semi-open structure to self-assessment and reflection, with both fixed/compulsory moments for assessment (T1, T3, T6), and optional but strongly suggested moments (T0, T2, T4, T5). The goal was to make sure that students who need more structure would feel supported. However, this does not fully reflect the open nature of self-directed learning, where students take full ownership of their learning.

Similarly, while students self-report the value of the platform in their reflection process, this data is not indicative of the quality of the reflections (as it was outside the scope of this project), and we cannot draw conclusions in this regard. Further educational research on this aspect could help us identify the need for complementary activities, particularly at curriculum level, to ensure students can interact with such tools effectively.

This pilot focused on the development of broader professional skills (e.g., 'communication', 'creativity', 'systems thinking', also referred to as *general* competences.). However, the development of *disciplinary* competences also is an important topic for CBL and education in general. Future work could investigate/evaluate the development integration of these two types of competences, allowing

for a more complete/rounded picture student's profile. Similarly, this pilot supported students during a 5-month period. Following students' development over a longer period (e.g., through a learning line, or series of modules) is important to attain key insights for the implementation of such tools at curriculum/program level.

Due to limitations on resources (time, budget), the present pilot did not explore sufficiently the flexibility of the tool (e.g., learning how to operate the admin interface and making changes in the setup independently). While the tool is flexible by design (it contains many forms and types of assessments to be implemented), we relied on the supplier for small and substantial changes, which is not ideal in innovation projects of this nature. This aspect is particularly important when implementing the digital platform in more complex settings (i.e., connecting multiple modules, multiple teachers and users, diverse needs, integrating disciplinary and broader competences). We will continue to investigate this flexibility of Scorion after this pilot, by using knowledge acquired in training to implement future changes to the system (user groups, forms, workflow and/or dashboards).

Finally, the data collected through the study and conclusions are not scientifically comparative, as we do not have evaluations on competence development prior to the pilot and cannot establish an objective delta. While we have learned a lot from this pilot and are thankful for having had this opportunity, we also feel that we have not acquired all the knowledge to be able to select a platform that can be used as a foundation as part of a university-wide implementation of the new Bachelor College of the TU/e. The scope of our pilot was specific to ISBEP, being one of the most innovative experimental interdisciplinary CBL courses of the university.

As innovation Space was set up as an expertise center for challenge-based learning and student entrepreneurship, and learning hub for education innovation, we aim to further develop insights and offer services and inspiration for the wider implementing of CBL. We therefore plan to continue our innovation with new pilots to get more experience with platforms for CBL learning in a more complex context. Table 5 below presents a list of relevant directions for future pilots.

Table 5. List of relevant directions for future pilots

- How to deal with combined feedback and assessment process for both 'disciplinary' as well as 'general' competences,
- The relation between individual and team-level learning, and how to effectively assess and use insights on the CBL team-level,
- Aligning development on course, curriculum and (eventually) student-level,
- Evaluate flexibility required in implementation process, in a more complex context such as a learning line or over 2 different departments,
- Coupling learning development to credentials (e.g., Edubadges),
- Possible integrations with extracurricular learning and/or professional development,
- Integration with existing SIS/LMS systems.

Recommendations TU/e Wide

Overall, we believe that the implementation of digital assessment tools can play a significant role in enhancing the effectiveness of challenge-based learning in the TU/e context. On the one hand, these tools allow students to practice their self-directed learning skills, and have the potential to help students maintain the overview of their overall development. These tools fit well with the Educational Vision at TU/e, which centers around flexible learning, student ownership and self-directed learning. We have observed in this pilot also that the use of a digital portfolio system can offer several advantages when implement well:

- Facilitates the feedback and assessment process,
- Provide insight in the learning progress, both to coach and student,
- Students become more aware of intended learning and take more control of their development,
- It has the potential to make CBL more scalable.

While the project reported in this document is of small scale and complexity (compared to a TU/e-wide implementation), we hope it serves as inspiration for educators and programs looking to implement similar tools.

In discussions about the project with other educators within TU/e, we experienced that the terms "digital portfolio", "eportfolio" and "monitoring systems" are used interchangeably depending on the educational context and the stakeholders involved. For example, some digital portfolio tools focus on tracking the distinct phases of activities that are part of a challenge-based learning project, such as the formulation of essential questions, guiding question, guiding activities, solution concepts and the progress in implementation and evaluation (Toschi et al., 2023). This is a different use-case from the reported pilot, where the focus is on programmatic assessment and (individual) competence development through recurrent reflection and feedback.

During the course of our pilot, we have also received considerable interest from other educators in the organization. While we clearly see the value of a digital portfolio / assessment tool for challenge-based learning, we recommend looking for a platform that offers the flexibility needed to account for observed differences in the way teachers want to implement programmatic assessment in their courses:

- Differences in learning outcomes and competences that they want to monitor/develop,
- Whether or not to allow students to define personal (self-defined) learning outcomes vs. predefined learning outcomes,
- Different scales in keeping track of progress (e.g., one to four stars vs, numeric scale of 1 to 10), sometimes the evaluation was guided by clear rubrics and sometimes not,
- Different combinations of assessment methods used (self-assessment, peer-assessment, assessment by external experts or challenge owners),
- Different types of information to be captured to demonstrate progress (e.g., documents, reflections, videos, images, etc.),
- Keeping track of individual students' performance vs. team performance, or both
- Differences in focusing only on generic competences, disciplinary competences, or both,
- Different ways in which the insights and aggregations of data are used by the teachers and/or assistants to intervene and coach the students,

- Whether or not to include EPAs as observable and measurable units of work that can correspond to competency milestone,
- Different approaches on how to include feedback on educational activities. The integration of learning, testing and (evaluative or more reflective) feedback can be used to support the individual learning process.

Further recommendations we want to make specifically following our pilot:

- Pay specific attention to designing a good user interface to provide an optimal user experience.
- Open reflection and trust by the students in the interaction with coaches is crucial to effectively support their learning process. As this often concerns entering private information on an online platform, we recommend ensuring that the private data of students can be handled responsibly, securely, and confidentially (e.g., through ISO:27001 and NEN:7510 certifications).
- Having enough flexibility in the tool to accommodate the different needs that can be encountered in our education (see e.g., list above).
- Having a data-driven system that can allow for appropriate data-based decisions (also in relation to learning analytics), and thereby can promote flexible and personalized learning.

Next to the insights mentioned above, we aim at providing practical advice to colleagues aiming to set up a similar pilot or implement a similar tool. Table 6 provides an overview of questions that can guide your innovation project.

Table 6. Guiding questions implementation digital assessment platform

- Is your vision on assessment, and assessment as learning set up clear?
- Is the purpose of the digital tool in relation to your design defined?
- Are possible users and desired functionality identified?
- Are key live interactions, not replaced by the digital platform, identified?
- Are the functional and non-functional requirements of any potential digital tool summarized in a comprehensive list? Is this list derived from the functionality needed based on the described approach to assessment as learning?
- Is the translation to these platform/software requirements detailed enough and understood and agreed upon by your innovation team?
- Is there a search and implementation plan in place, for selecting a suitable tool?
- Are assessment tools to be embedded in the platform already designed and piloted?
- Is there enough time to set up and adjust the system to the workflow and assessment methods to be implemented?
- Is there an evaluation plan in place?

- ***Start with your vision on assessment (module or curriculum).*** Map your assessment as leaning plan, clearly defining the diverse types of assessment procedures and moments in time where they take. Also define when an intermediate and final (summative) assessment takes place and actors involved. In this stage, it helps thinking of the ideal scenario, leaving out any constraints from the learning environment.

- ***Define the purpose of the digital platform in relation to your design.*** How should the platform support your vision? Who are the users? Are there different use groups (i.e., students, coaches, academic assessors, challenge owners, external parties)? When do they use it? What type of functionality do you require, per use group to realize your vision?

- ***Keep a balance between in-class and platform procedures.*** Students value face-to-face moments with students, coaches, and other stakeholders. Key live interactions should be safeguarded and supported with the platform when apt. In our project, mapping the assessment setup in time, clearly outlining learning activities, assessment procedures/moments, and key stakeholders, helped assess this balance.

- ***Translate needs into a list of requirements to guide your search for a tool.*** As inspiration, Appendix D presents our revised list of functional requirements. This list was used when searching the market for a suitable tool in several ways. First, in making a first evaluation and pre-selection of vendors to contact to plan demo sessions. Second, to discuss the sought functionality with providers. And third, to aid the discussions within the innovation team. We also recommend reaching out to LIS for an overview of tools accessible via TU/e. SURF also provides regular scan of the market of portfolio systems and classifies them (see e.g., https://www.surf.nl/files/2023-09/sf-e-portfolio_def.pdf).

- ***Plan and take your time.*** For our project, a period of about 12 months prior to rolling out the platform was required to design the assessment as learning setup, arrange demo sessions with possible vendors and choose a suitable tool. It took about two months (prior to implementation) to set up the tool and make necessary adjustments.

- ***Start small when necessary.*** Full implementation and roll out is not always the best approach. Particularly, when there is uncertainty about the assessment procedures and their impact on learning. In such cases, we advise using the platform to support nominal changes in the assessment set up, adding to it as you learn from how students experience the platform and procedures.

- ***Design assessment tools to be embedded in the platform carefully.*** Pilot/test these tools in analog form first whenever possible. While changes in the assessment setup of the digital platform will occur, you can help minimize these changes, particularly regarding how reflection and self-assessment questions are formulated.

- ***Evaluate and Co-create with students and other key stakeholders:*** Ideally, involve an educational designer or research who can keep and overview of the intervention, and draft a plan to evaluate the intervention. When not possible, teachers can implement in-class evaluation moments, such as the plenary discussions described in Section 4.3. Informal follow-ups with students are also advisable, to keep track of any incidents in the interaction with the platform, or lack of clarity of its purpose.

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				Beginning		Emerging		Proficient		Advanced
				Relies on support from others		Building Independence		Taking Responsibility		Self-Regulated development/growth
				ISBEP Students at a given level are:						
Competence		ILO		Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
Relation to Others	Design & Research Process	1	Identify the needs of different stakeholders and integrate them in a viable solution.		Identify the stakeholders and their needs. Support in translating stakeholder needs to interdisciplinary project goals/plans.	Identify the stakeholders and their needs.	Support in identifying the needs of stakeholders. Support translating stakeholder needs to individual & interdisciplinary project goals/plans.	Identify the stakeholders and their needs. Explain how stakeholder's needs were considered in the individual project.	Limited support in synthetizing stakeholder's needs. Explain how stakeholder's needs were considered in the interdisciplinary designed solution.	Explain how stakeholder's needs were considered in the interdisciplinary designed solution. Independently draw links between the interdisciplinary designed solution and the disciplinary (individual) component.
		ILO		Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
		2	Identify the interdisciplinary problem that needs to be solved within the societal challenge, and the disciplinary components.	Understand the team challenge.	Support in defining an interdisciplinary problem statement. Support in identifying the problem tackled with the disciplinary component. Support linking the disciplinary component/project to the interdisciplinary problem.	Understand the team challenge. Define the interdisciplinary problem statement.	Support in defining the problem tackled with the disciplinary component. Support linking the individual project to the interdisciplinary problem.	Describe the problem tackled with the interdisciplinary project, and how it relates to the societal challenge. Explain the problem tackled with the disciplinary component. Explain the link between the disciplinary component and the interdisciplinary project.	Support in relating the interdisciplinary designed solution to the broader societal challenge.	Independently explain the problem tackled with the disciplinary component. Independently explains how the disciplinary component relates/connects to the interdisciplinary designed solution. Relates the interdisciplinary designed solution to the broader societal challenge.

Relation to Others

			Beginning		Emerging		Proficient		Advanced
			Relies on support from others		Building Independence		Taking Responsibility		Self-Regulated development/growth
Competence		ILO	Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
Interdisciplinary collaboration	3	Collaborate with people from other disciplines in a way that benefits both individual and team development. Collaborate with people from other disciplines, based on identified roles within the team.	Provide constructive feedback to team members.	Recognize the role they can play in the team. Recognize some challenges in the interdisciplinary collaboration. Adapt specific individual behaviour based on peer feedback.	Provide constructive feedback to teammates. Recognize the role they can play in the team. Recognize some challenges in the interdisciplinary collaboration.	Adapt specific individual behaviour based on peer feedback. Support in managing identified challenges in the interdisciplinary collaboration.	Adapt specific individual behaviour based on peer feedback. Identify and handle challenges in the interdisciplinary collaboration independently. Demonstrates awareness of how their role can influence team collaboration.	Misses a full understanding of team members' contribution to the team outcome.	Identify the different roles within the team and how they contributed to the team's outcome. Contributes to the development of the team by supporting the development of team members and their competencies. Cooperate as team in coping with challenges in the interdisciplinary collaboration.
Competence		ILO	Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
Systems thinking	4	Demonstrate the ability to approach the project with a holistic perspective by clearly denoting the interrelations between individual contributions and their boundaries.		Map the interconnectedness among different elements that contribute to the interdisciplinary project. Define the boundaries of the interdisciplinary project.	Identify the different elements that contribute to the interdisciplinary project. Create a basic map that demonstrates the connections and boundaries within the interdisciplinary project.	Define a realistic scope for the interdisciplinary project that utilizes the boundaries and connections.	Develop a complete map that demonstrates the connections and boundaries within the interdisciplinary project. Define a realistic scope for the interdisciplinary project that utilizes the boundaries and connections.	Adapt the project and its goals to the changing boundaries of the interdisciplinary project. Elaborate on the implications of the project's limitations, and the next steps for the designed solution.	Develop a complete map that demonstrates the connections and boundaries within the interdisciplinary project. Adapt the project and its goals to the changing boundaries of the interdisciplinary project. Provide feasible and viable advice to challenge owners on the next steps of the project, based on limitations and boundaries of the interdisciplinary project.

			Beginning		Emerging		Proficient		Advanced
			Relies on support from others		Building Independence		Taking Responsibility		Self-Regulated development/growth
Relation to Others	Envisioning — Competence	ILO	Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
		5 Translate the individual components into an integrated demonstrator.		Support in identifying the possible ways to envision a solution. Support in envisioning a demonstrator that integrates the individual components.	Identify the possible ways to envision a solution.	Support in envisioning a demonstrator that integrates the individual components.	Develop a demonstrator that shows the relation between individual components. Demonstrate awareness of the possible ways to integrate the individual solutions.	Integrate the individual components into one demonstrator.	Develop an integrated demonstrator to illustrate the interdisciplinary solution.
Relation to Self	Dealing with uncertainty — Competence	ILO	Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
		6 Manage uncertainty, ambiguity and risk in the open-ended challenge.		Relate the individual project to the interdisciplinary project goals and its planning. Support in identifying the resources needed to bring the interdisciplinary project to completion.	Relate the individual project to the interdisciplinary project goals and its planning.	Support in adjusting planning, organizing work related to the interdisciplinary project, and undertaking action if needed. Support identifying the resources needed to bring the interdisciplinary project to completion.	Develop and perform a planning for the interdisciplinary project. Identify the resources needed to bring the interdisciplinary project to completion.	Limited support in adjusting planning, organizing work related to the interdisciplinary project, and undertaking action if needed.	Independently plans and organizes work between individual and interdisciplinary project and undertake action if needed. Timely identify the resources needed to bring the interdisciplinary project to completion. Shows an ability to adjust the planning for the interdisciplinary project.

| Competence | ILO | Beginning | | Emerging | | Proficient | | Advanced |
| | | Relies on support from others | | Building Independence | | Taking Responsibility | | Self-Regulated development/growth |
		Able to:	Is not able yet/require:	Able to:	Is not able yet/require	Able to:	Is not able yet/require	Able to:
Reflection on learning	7 — Critically and constructively evaluate own actions, the role that they have played in the interdisciplinary team, and its impact on professional identity.	Is aware of the value of the interdisciplinary collaboration.	Incorporate peer feedback in their reflection. Does not yet translate experiences and learning into concrete goals for future development.	Is aware of the value of the interdisciplinary collaboration. Incorporate peer feedback in their reflection.	Support in connecting experiences to learning. Guidance in reflecting how the obstacles and opportunities faced during the interdisciplinary project impact their professional and personal growth. Does not yet translate experiences and learning into concrete goals for future development.	Reflects and understands how their role in the interdisciplinary project has further shaped their professional identity. Reflects on how the obstacles and opportunities faced during the interdisciplinary project contributed to their professional and personal growth.	Translate experiences and learning into concrete goals for future development.	Reflects and understands how their role in the interdisciplinary project has further shaped their professional identity. Reflects on how the obstacles and opportunities faced during the interdisciplinary project contributed to their professional and personal growth. Defines concrete goals for future professional and personal development based on reflection.

Relation to Self

Disciplinary/Content Knowledge

Defined by departments/program

Appendix B: Overview of guiding questions for reflection, T1-T6

The following questions are used in the platform to support the reflection process of students. Reflection questions at each T-moment are preceded by self-assessment by students on each ILO with the support of the Development Guides. The figure below provides a graphical example of this set up. After students have filled in their self-assessment for each ILO (personal and general), they reflect on their learning/growth guided by the questions below.
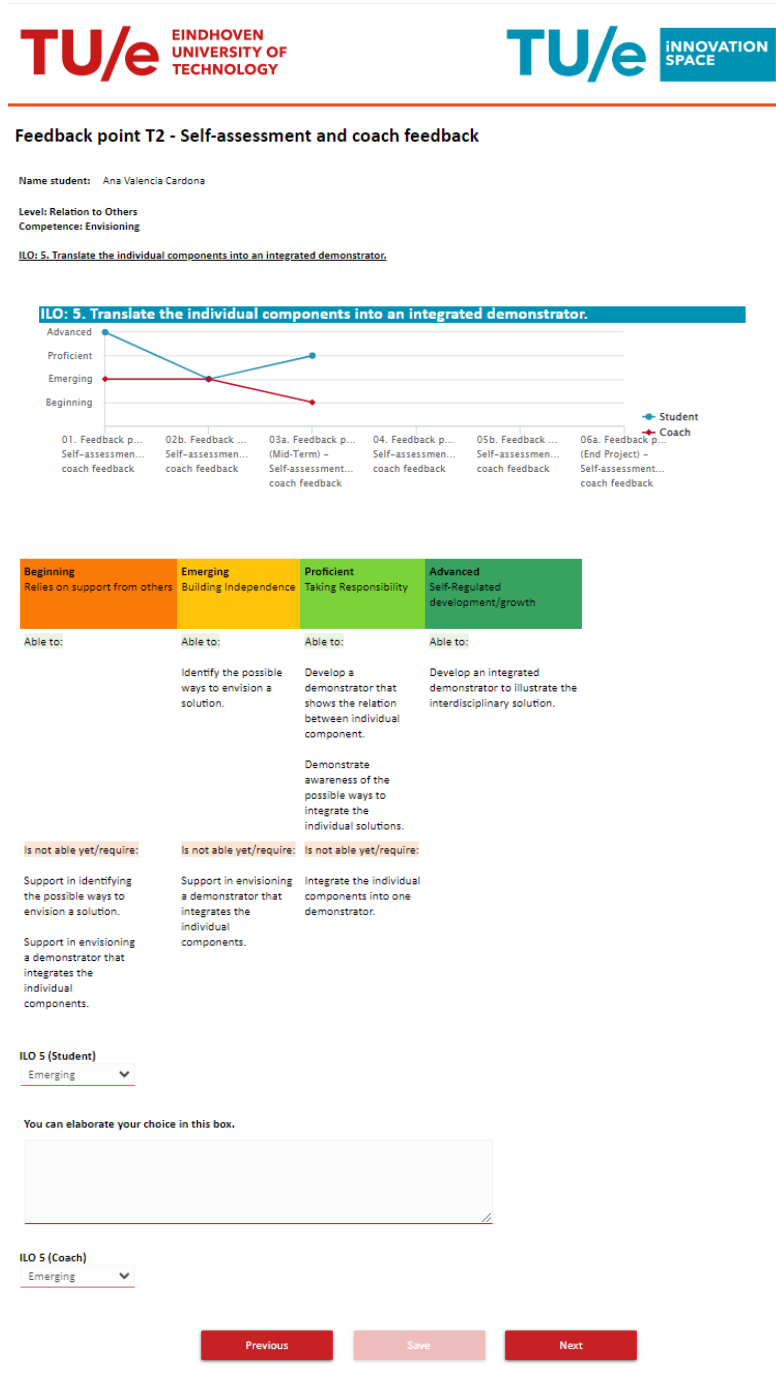
Figure 5. Self-assessment per ILO, preceding the reflection at each T-moment.

Feedback Point T1 (Start of the Project): Self-assessment and coach feedback.

We would like to hear about your expectations regarding ISBEP. In filling in the box below, you could think of answering the following questions:

What are you looking most forward to in ISBEP? Why is this aspect important/interesting for you? What do you think will be important for you to do to get the most out of the project? How do you think ISBEP can help you achieve your professional ambitions?

I am most looking forward too...

Feedback Point T2, T4, T5: Self-assessment and coach feedback

In the following boxes, we would like you to reflect on the most relevant learning experiences and challenges you faced in the last two weeks. In doing so, connect to your self-assessment and development whenever possible. Use the listed question to guide your reflection:

Regarding the challenges you faced:

What was the greatest challenge in the last two weeks? Why was it challenging? How did you approach this challenge? In what way was it important for your progress? Would you approach it in the same way again or differently?

Regarding your learning experience:

What was the most important thing you realized/learned in the last two weeks? What made/helped you to realize this? Why do you believe it is important?

Regarding your next steps:

What will you focus on in the coming weeks? What will your next actions be?

Feedback point T3 (Mid-Term) - Self-assessment and coach feedback

We would like to hear your reflections and impressions on your development so far, as well as to hear about your next steps. In doing so, connect to your self-assessment whenever possible:

Regarding your development so far:

What are the main take-aways from the project so far? How do you feel about your learning and development within ISBEP? Do you feel that you are on track and why?

Regarding your next steps:

What do you think will be the most important next step for you within ISBEP? What do you want to focus on? How will you work towards reaching your (personal) development goals?

Feedback point T6 (End Project) - Self-assessment and coach feedback

Now that ISBEP is coming to an end, we would like to hear your thoughts on your overall development.

Regarding your overall development:

What are the main take-aways from the project? How do you feel about your overall learning and development within ISBEP? What are you satisfied with? What would you do differently if you would do it again?

Regarding your professional ambitions:

How did ISBEP contribute to your understanding of the type of engineer you aspire to be? After ISBEP, what will you focus on in your development? How will you work towards reaching your development goals?

Appendix C: Illustrative images of the look and feel of the platform

Overview of forms and assessment as learning moments:
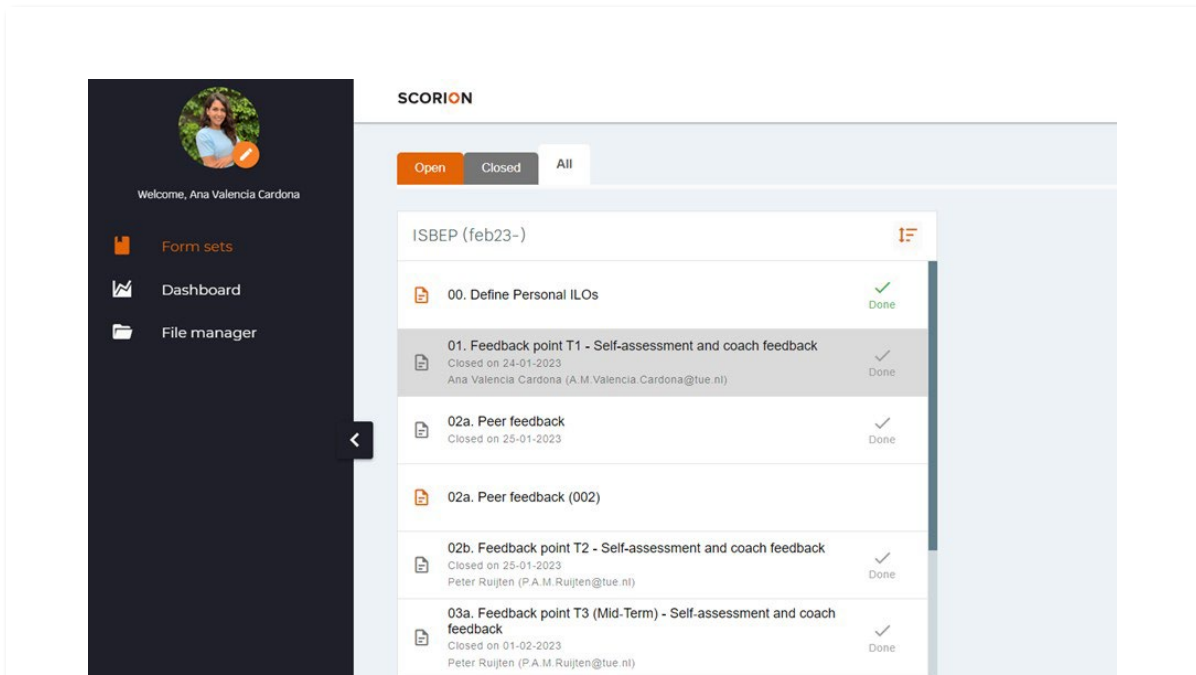
Defining Personal ILO's connected to supported competences:

Rubrics embedded in the platform, which guide assessment as learning activities:

Feedback point T1 - Self-assessment and coach feedback

Name student: Ana Valencia Cardona

Level: Relation to Others
Competence: Design & Research Process

ILO: 1. Identify the needs of different stakeholders and integrate them in the viable solution.

Beginning Relies on support from others	Emerging Building Independence	Proficient Taking Responsibility	Advanced Self-Regulated development/growth
Able to:	Able to:	Able to:	Able to:
	Identify the stakeholders and their needs.	Identify the stakeholders and their needs. Explain how stakeholder's needs were considered in the individual project.	Explain how stakeholder's needs were considered in the interdisciplinary designed solution. Independently draw links between the interdisciplinary designed solution and the disciplinary (individual) component.
Is not able yet/require:	Is not able yet/require:	Is not able yet/require:	
Identify the stakeholders and their needs. Support in translating stakeholder needs to interdisciplinary project goals/plans.	Support in identifying the needs of stakeholders. Support translating stakeholder needs to individual & interdisciplinary	Limited support in synthetizing stakeholder's needs. Explain how stakeholder's needs were considered in the interdisciplinary	

Written personal reflections per ILO:

Is not able yet/require:	Is not able yet/require:	Is not able yet/require:
Identify the stakeholders and their needs. Support in translating stakeholder needs to interdisciplinary project goals/plans.	Support in identifying the needs of stakeholders. Support translating stakeholder needs to individual & interdisciplinary project goals/plans.	Limited support in synthetizing stakeholder's needs. Explain how stakeholder's needs were considered in the interdisciplinary designed solution.

ILO 1 (Student)

[Emerging ▼]

You can elaborate your choice in this box.

[   ]

[Previous]   [Save]   [Next]

Feedup, Feedback, Feedforward questions that guide overall reflections:

Overall reflection student

In the following boxes, we would like you to reflect on the most relevant learning experiences and challenges you faced in the last two weeks. In doing so, connect to your self-assessment and development whenever possible. Use the listed question to guide your reflection:

Regarding the challenges you faced:

What was the greatest challenge in the last two weeks? Why was it challenging? How did you approach this challenge? In what way was it important for your progress? Would you approach it in the same way again or differently?

Regarding your learning experience:

What was the most important thing you realized/learned in the last two weeks? What made/helped you to realize this? Why do you believe it is important?

Regarding your next steps:

What will you focus on in the coming weeks? What will your next actions be?

Peer feedback as input for in-class guided reflection:

Peer feedback

ILO: 1. Identify the needs of different stakeholders and integrate them in the viable solution.

| What am I doing well?	What can I do better?
	mnmnnbmgjf

ILO: 2. Identify the interdisciplinary problem that needs to be solved within the societal challenge, and the disciplinary components.

What am I doing well?	What can I do better?
ngfdyttd	

ILO: 3. Collaborate with people from other disciplines in a way that benefits both individual and team development. Collaborate with people from other disciplines, based on identified roles within the team.

What am I doing well?	What can I do better?

Line-graphs (per ILO) that support the assessment as learning activities:
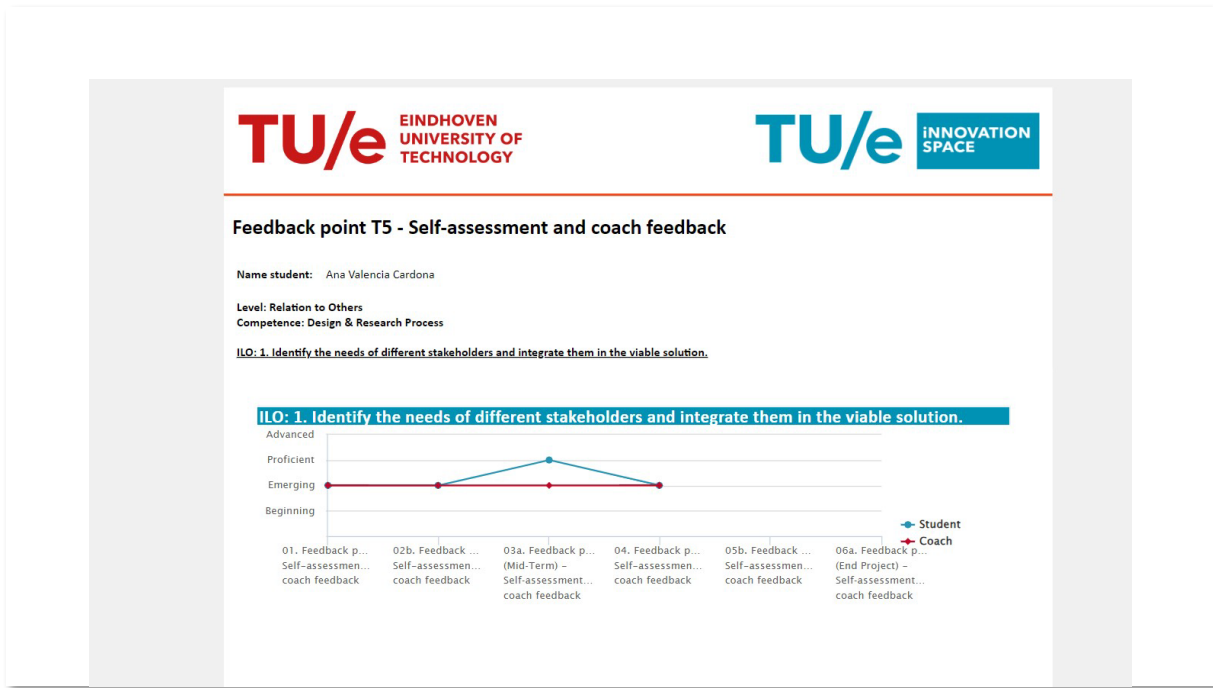
Spider-web graph at competence level, growth overtime:

Appendix D: Resulting list of functional requirements

Based on the software implementation experience and the analysis of the insights gathered from students and teaching staff, a list of functional requirements was created. This list indicates requirements that any learning management system platform must satisfy to be successfully implemented in the context of ISBEP. Descriptions are high-level only.

No.	Description
1	Support development of personal development plan
2	Feedback mechanisms
2.a	Provides ability to teachers and students to initiate feedback moment
2.b	Supports communication threads and filtering on feedback moments
2.c	Alerts through email
3	Feedback types
3.a	Can provide text-based input
3.b	Can provide files-based input (PDF, Word, Excel)
3.c	Can provide images and videos
4	Assessment of student feedback level in relation to particular question over time
5	Assessment of student feedback at competency level
6	Visual feedback on competency growth (graphs)
7	Overview development at student level
8	Overview development at team level
9	Reflection on competency level by other students
10	Reflection/communication at team level
11	360 degrees assessment
12.a	Feedback from coaches/tutors
12.b	Assessment by Academic Coaches
12.c	Input from Challenge Owner/external parties (external to TU/e)
13	Flexibility for customization by users (teachers)
13.a	Add different types of forms for obtaining feedback
13.b	Add different types of visualizations on collected data
13.c	Entry of different data points
14	Programmatic Assessment (Competency development throughout program)
15	Possibility to upload support material (files) per data point
16 NFA.	Integration with other systems
16.a	Canvas
16.b	MS Teams
16.c	Single Sign-On
17	Integration of Rubrics and other assessment tools
18	High configurability of dashboard by staff members, flexibility
19	Printable summary page
20	Suitable for mobile devices; access via tables or smart phones

Further non-functional requirements were reviewed based on standard requirement lists available through LIS enterprise architecture team. More detailed software requirements were developed as part of the design and setup of the first configuration of the system.

For more information:

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ISBEP Study guide:

https://educationguide.tue.nl/programs/innovation-space/bachelor/isbep-innovation-space-bachelor-end-project