Handling assessment when including CBL in your course

Version 16th June 2021

Content

If you have any comments, suggestions or other feedback please contact:

Siska Simon	siska.simon@tuhh.de
Frank van den Berg	f.m.j.w.vandenberg@utwente.nl
Svante Gunnarsson	svante.gunnarsson@liu.se
Katrin Billerbeck	katrin.billerbeck@tuhh.de

Introduction, purpose and scope

Great that you have decided to include Challenge Based Learning (CBL) in your existing course, as a way to improve the education and the learning of your students. Together with you and the students we want to make this a great learning experience.
The purpose of this document is to give you some support and ideas concerning assessment when you implement CBL into your course. The hope is that the document can be useful for teachers at all universities within the ECIU University, but it is important to keep some aspects in mind when reading the document:

- There can be differences in *national and local regulations and processes* concerning how much freedom you as teacher have in changes in the course related to learning goals and assessment and which approval you need for this from whom; please check in your own regulations.
- There can be differences in the interpretation of the word assessment: In this document we use the word *assessment*, which is related to both examination and evaluation and grading.
- In using a didactic approach like Challenge Based Learning the students will have the possibility to develop a wide range of competences like independent self-structured working, creativity, critical thinking-, international and interdisciplinary collaboration skills or digital and oral communicative abilities (see Section 2.4) besides the respective (disciplinary) knowledge. To simplify this in the following we will often just use the words *knowledge* and *skills.*

With this document we focus on CBL in existing courses. Maybe there is an entire module that can be switched to CBL, maybe CBL will just be part of the course. For the students it is then important to know, what expectations you are able to meet in your course and what degrees of freedom they have. There is another document concerning reflection and evaluation in general, which could be helpful as well. It is called “CBL Assessment-teacher-extracurricular_final”. If you are interested in it, please contact us.

In the remainder of this document we will discuss several topics related to CBL and assessment: We start with the “Learning Goals in CBL in existing courses” (1), after that we will make some Recommendations concerning “Assessment in CBL” (2) and in the end we briefly note something about “Grading in CBL” (3).

1. Learning Goals and CBL in existing courses

When you introduce CBL in an existing course, most of you will already have a set of Intended Learning Outcomes (ILOs) of the course, the topics you want the students to know and master at the end of the course. We assume that there is already constructive alignment[1] in your course. As CBL gives more freedom and responsibility to the students in making their own choices including choosing their own learning objectives, it would be great if you could customize your existing ILO’s or add some.

[1] Constructive Alignment: the direct relation between Intended Learning Outcomes of the course (the learning goals), the Teaching and Learning Activities you do in a course (what you and the students do) and the Assessment (how and what you test). See also Biggs and Tang, 2007.

Customize existing ILO's:

Do the current ILOs specify exactly what a student should do, or do they give some choice for the student?

- TIP 1: Open your learning goals:

Example:

- From: 'after this course, the student is able to apply theory A, theory B and theory C on a given situation'.
- New: 'after this course, the student is able to select and apply the most appropriate theory for a given situation'.

The latter ILO has as effect that the students will learn about all three theories including pros and cons, otherwise they cannot choose the most appropriate for the given situation. At the same time, this formulation gives the students some freedom in applying only one theory on a given situation, which is often the case in a CBL setting.

Adding ILO's:

As stated, CBL includes that students can choose their own ILO's.
If they are additional to the existing ILO's you could e.g. add two ILO's that the students can choose themselves: e.g. one is regarding (disciplinary) knowledge and one on personal and social skills. In any case it is important, that the students train to set goals for themselves (and get support in this), reflect on their progress and get feedback – that's an important part of CBL.
Examples:

- I can independently structure my work, distribute work in a group and align my actions with common goals
- I can weigh up the advantages and disadvantages of a solution in a well-founded manner.
- I can present a solution, developed in a team, professionally in appropriate language.

2. Assessment in CBL

CBL is not only about developing technical knowledge, but also focuses on the development of personal and social competencies, the assessment formats should be appropriate to this. It is recommended to distribute different assessment forms throughout the CBL process and not only provide feedback on the final result at the end.

- TIP 1: As you know, CBL has 3 phases each with 3 steps, and all steps have a concrete outcome. These outcomes can be used to check the progress of the students, to give them feedback (both on content as well as on the process) and even check whether they really understand the topic. As such, when introducing CBL in your course you have many natural points for assessment (see also 2.3)

- TIP 2: We recommend to give the learners some responsibility for the assessment as well. That means that not you as teacher formulate all of the assessment tasks but ask the student to indicate how they will show that they have mastered the ILO's. That way you do not have to think of questions or assignments, but only need to review the evidence the student will supply. This is easier if you are free to choose assessment formats in your course but also if your exam form is already defined you can integrate this approach.

- TIP 3: It can be a good idea to involve the challenge provider as an advisor, in the evaluation and assessment process. It can, for example, be motivating for the students to notice the interest in their work from the challenge provider. In addition, the challenge provider can give useful feedback at oral presentations or similar. However, the challenge provider should not decide about pass/fail or the grades because this is the task of a teacher/examiner.

The exact form of the assessment when applying CBL depends on how much flexibility you have. We would now like to give you a few recommendations for already existing or still free assessment formats. Afterwards we will especially have a look to the continuous assessment via the work process and the
assessment of personal and social skills.

2.1 Adapt and add assessment in existing courses

If your exam format is already defined, you can adapt it to CBL and integrate additional formats - matching the new ILO's. Some Examples without claim to completeness:

- If you are using a **written exam** you might be able to create new questions addressing the new learning goals. Think about open questions that require creativity in answering them.
- If you have to do an **oral examination or presentation** you could add questions, so students can also show that they reached the new learning goals. You can have learners present some of their work on the challenges in an oral examination or presentation.
- If you have to make them **write a report** this new learning goal could be added as one of the criteria. Please be advised that it is important not to just add some points to the table of content but to leave out other parts so the overall workload won't change.

2.2 Conception of a new assessment for CBL

If you can plan your assessment without restrictions, design it fitting to the new learning goals and choose a flexible assessment mode, if possible student driven (see Appendix 1). It is helpful if the timing of the assessment can be varied, as well as the formats. Orientate yourself on the phases of CBL and what is to be achieved in each of them.

If the learning objectives are partly self-selected, you may not feel as an expert in some topics. This is also part of CBL that your role changes more to a learning guide. If you don't feel comfortable with this, you can involve colleagues or other stakeholders to give feedback to special topics.

Some examples of possible assessment approaches are given in the appendices.

2.3 Continuous assessment via the work process

A CBL learning activity is based on the three stages Engage-Investigate-Act, with three sub-stages for each of the main stages. Such a work process, mapped to a timeline, enables continuous feedback and even continuous assessment during the time the team works on the challenge. This can be done in different ways, both in terms of number of times and type of activity. The completion of each of the stages in the CBL sequence is one opportunity, but the continuous assessment can also include short, weekly reports on the progress of the work, both individually and on team level. Appendix 3 presents an example where the use of a so-called project model to support the work process is used to support the assessment of various skills.

- TIP 1: To improve the ability to set up a project and time plan, the learners can also take this as a learning goal. The plan should then be followed-up and adapted regularly and be used to give feedback to the team.

- TIP 2: A simple but efficient way to follow-up that the students put in the expected number of hours is to request weekly status and time reports consisting of a few sentences describing the progress and an estimate of the time spent.

Reflection and feedback are important components for learning and assessment, and these tools can be used in several ways. Reflection can be carried out both on individual and on team level, and at one or several stages along the work process. In addition, the reflection can be done on different levels of detail, from a relatively simple one based on a few items to an extensive reflection document. Similarly, feedback can be used in several ways and at several stages in the work process. The feedback can be given peer-to-peer, team-to-team, teacher-to-student, teacher-to-team, etc. and on different levels of detail. It is difficult to give any general recommendations than starting in a small scale with something not too complicated. You can find additional information on and evaluation grids for reflection and feedback in the document "CBL Assessment-teacher-extracurricular_final". If you are interested in it, please contact us.

Requiring the students to do reflections is included in the CBL methodology, and can also be used as one type of assessment. If you do this, be sure that the students reflect on all ILO's of your course and support their claims with evidence. In CBL it is not possible to do only assessment and no reflection at all – at least at the very end of the course there has to be a group reflection on the whole course. Whether you want to grade the reflection and include that mark in calculating the final mark or whether it is a pass/fail for the reflection, is up to you.

2.4 Assessment of personal and social skills

CBL is a great opportunity to assess in a creative way being fair and concerning individual learning paths and the development of personal and social skills like communication, cooperation, critical thinking etc. (sometimes called 21st century skills or the 4 Cs) and also independent work and sustainable self-assessment, as the ability to undertake those activities that necessarily accompany learning throughout life. All these various skills appear in several other contexts, and the question of assessment of them is hence not restricted to CBL and the ECIU University setting. We will give some recommendations in the following.

- TIP 1: You could design a rubric, where you describe what kind of behavior the student would need to show on the specific personal or social skill. For ideas on different forms of rubrics, please see appendix 4. Examples for some of the competences – which are specifically focused depends on the ILO's:

Assess Creativity:
Creativity could be defined as 'the ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc.; originality, progressiveness, or imagination'[2].
To assess creativity, you should define criteria based on the definition above, or another definition you want to use. What makes the solution creative (e.g. is this approach already known or more or

[2] source: https://www.dictionary.com/browse/creativity

less new? Is it oriented towards conventional approaches or does it go beyond or cross these?) or less creative. Develop criteria together with stakeholders or students or with colleagues. This can be a part of your grading (see also 3).
To train and assess this skill you could also:

- Let them reflect on their amount of creativity using the criteria
- Integrate unusual questions like “In 1000 years how would your product look like?”

Assess Critical thinking:
Critical Thinking can be defined as: the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness.’[3].

To assess critical thinking, you should define criteria based on the definition above, or another definition you want to use. What does critical thinking mean in the context of your course and how can you measure it?). Examples could be ‘systematic approach’, ‘compares different sources’, ‘accuracy in reasoning’ etc. You might want to develop the criteria together with stakeholders or students or with colleagues. To train and assess this skill you could:

- Let the learners search specifically for alternative hypotheses, explanations and causes, for alternative plans and solutions. Have them write a report or give a presentation on what the alternatives were and why exactly they chose their solution.
- Let the different teams review the ideas, approaches and solutions by the other teams.
- Integrate a role play with students being pro and con. Let other students give feedback to that.
- Let students write down criteria what makes their result a good result

Assess Communication:
Communication involves many components, such as written communication, oral communication, and the use of electronic media, but it is also encompasses listening, begin able to discuss and give feedback in a constructive way, argue for a standpoint, negotiate, etc. Giving feedback and assessing a written report is probably the most common way to assess communication skills, while some of the other aspects may be more challenging. Using the various forms of feedback mentioned above (peer-to-peer, teacher-to-group) can be one possibility. Including communication activities at several stages along the work process enables progression and continuous assessment of different types of communication skills. Another possibility is to include this aspect in the assessment of collaboration in self- and peer evaluation (see next paragraph).

Assess Collaboration:
Collaboration and teamwork also involve several aspects such as the ability to form the team, share the different roles, set up common rules for the work, ability to manage conflicts in the team, and to replan the work in case the circumstances for the work change. It is often useful to link this to the work process and have regular contacts between the teacher and the team. This can be done in different ways, from weekly meetings when the team is asked to deliver a brief written status and time report, to more informal contacts. Normally you would integrate in your CBL course assessment on an individual and a team level (if possible). However, assessing on team level should include some

[3] source: https://www.criticalthinking.org/pages/defining-critical-thinking/766

way to ensure that all team members have contributed. This can be done e.g. via the reflections that the students will write in CBL.

- TIP 2: Important here is also that there is self- and or team-evaluation and feedback. Inclusion in the grading is not necessary.

There should be at least one occasion for reflection at the end of the work, but it can also be used along the work process. The reflection can be done individually or collectively in the team. However, it should be stressed that although reflection is one of the essential parts of CBL, it is nothing unique for CBL. Summarizing the "lessons learned" is a standard step in many team-based learning activities.

A tricky, and sometimes sensitive, aspect is to monitor if the workload in the team is shared in a more or less balanced way, and that all team members contribute to the team. This can also be included in the reflection but one can also ask the students for regular time reports. Time report or not, this is an important topic for discussion during the regular contacts between the team and the teacher at several occasions during the work process. Another related aspect is to strive for a trustful relationship between the team and the teacher, so that the team members can bring up issues related to the team operation with the teacher. Keeping in mind the challenge in assessing such a learning goal it can still be valuable to have one learning goal stating that each team member should "actively contribute to a well-functioning team".

Although you as a teacher will probably have some insight in the cooperation in the team, the team members themselves will have the best overview. It might be wise to use self- and peer evaluation for this competence. There are online tools available for this, maybe your institute has incorporated these already in their Learning Management System (e.g. some universities use Buddycheck). Alternatively, you could ask the students to have group meetings to discuss their cooperation. E.g. let them discuss what their group does well on each of the criteria of cooperation, and what they could improve on that aspect. You can take it a step further by also asking this on an individual level: each student evaluates their own performance (both what is good as well as what can be improved), and the performance of each team member. The evaluations of the team members can then be compared with the self-evaluation. This will most likely lead to interesting discussions. It might be good to coach this kind of discussion as teacher, as it might become personal. The students could also include this information in their own reflection.

Example form

Criterium: **plan our work**	Good is	Can be improved
Group as a whole		
Myself		
Student A		
Student B		
…		

3. Grading

Assessment normally comes together with grading. CBL is carried out in teams, so this leads to the question of assessment of teamwork. There are several alternatives to do this; pass/fail or grades, individual or team based. This document does not advocate any particular of these alternatives; if CBL is a new element, it is suggested to start as simple as possible.

- A Learner has passed the course when all learning outcomes have been assessed and the learner has shown that he/she has reached them.
- He or she has failed, when the learner has been given clear feedback, at several stages, saying that the expectations are not fulfilled and there have not been signs of improvement of sufficient magnitude.

This can probably be supported by utilizing a structured work process with regular contacts between the team and the teacher. If you have to give grades or not is probably related to the national/local regulations concerning grading at your university.

In CBL feedback during the whole process is very important (on e.g. the outcomes of the different CBL-steps) and the students reflect on their own activities and learning, you might want to reconsider whether grades will add to the students' learning, or whether a pass/fail in combination with the feedback given is sufficient. If you, as a teacher can influence this, it is often a good idea to start as simple as possible.

- TIP: If you can choose freely a pass/fail grading would give you more freedom in your decisions.

Appendix 1

Example@TUHH: A flexible and agile assessment format

To have freedom to choose assessment methods for the CBL-course and also for the transitions between old and new course design, at TUHH students, teachers together with experts in this field and the Center of Teaching and Learning (ZLL) developed a format that allows more flexible assessment:

1. *What are the core characteristics of the example?*

The "practical examination" (in German: Fachtheoretisch- fachpraktische Arbeit) allows teachers to be very flexible with the design of the assessment:

"A practical examination examines the student's practical application of theoretical principles. It may include developing a technical product, documenting a process or experiment, and/or an oral presentation. It may also be divided into a number of in process and end-of-process sections tested throughout the semester." (General Study and Examination Regulations TUHH)

They are allowed to use different kind of assessment types (oral or written) during the semester and/or in the end of the semester - the only thing they are not allowed to use is a written exam. At the end, you can give an overall mark for everything you would like to include: e.g. written or oral reflection, portfolio, podium discussion, essay, reports, protocols, presentations, stakeholder interaction documentation, …
You can also include the student's opinion when you decide on the weight of the components of the course assessment. This too adds to the student's centeredness in CBL.

2. *Why is this example useful for making CBL work in curricular settings?*

To assess CBL you need the freedom to choose types of examinations, that

- can be adapted to individual learning objectives, that could not be planned long beforehand
- involve the learning process and can be divided into the phases of CBL
- are suitable to give feedback to individual learning results and to learning results in groups

3. *What do you need to consider?*

- If your university has an open assessment format like "practical examination" maybe it makes sense to use it, because CBL does not match with written examination only.

- Please be aware of the deadlines of your university to change an examination type. At TUHH you have to change the examination for a course 1 until 1,5 years before implementation.

Appendix 2

Example @ UT: Course "Nanotechnology Design Project"

1. *What are the core characteristics of the example?*

Master course, where students are asked to design a nano-device of their own choice, and consider business aspects/opportunities for this device. Students have full freedom in choosing what target group they want to aim at, what problem they would like to work on and what solution they would like to design. The intended learning outcomes are formulated at this broad level.

Example: "Students should be able to design a nano-device, both in terms of device physics and clean room fabrication process, and design a unique solution to solve a customer problem with the help of this nanotechnology-based device"

Further specification is given what students should be able to do for making this nano-device. The set-up guarantees that the students will first focus on the actual question (what is it we want to solve), and only later will dive (deep) into the technology.

2. *Why is this example useful for making CBL work in curricular settings?*

It is a nice example in how you can combine giving freedom to students to make their own choices while at the same time guaranteeing that students will learn also content-wise (in this case: design a nano-device, find business aspects). By giving some conditions or requirements, this is safeguarded.

3. *What do you need to consider when planning to use it?*

You might have to reformulate your learning objectives at a slightly more abstract level. Be clear on what final results the students have to deliver and what criteria you will use to assess the final products. It helps when you as coach of a student team know the content of the topic, when necessary you can correct contributions. In addition, this knowledge helps you in deciding what questions to ask the students so that they can continue. Furthermore, you will learn a lot yourself as teacher, as students will come up with questions and information you yourself haven't thought of.

Appendix 3

Example@LiU: Use of a structured work process for continuous assessment.

The key message of this example is that the use of a structured work process can be of great help for continuous assessment of knowledge and skills in challenge-based learning.

There are two main components to consider:

I. Intended learning objectives (ILOs) for knowledge and skills, possibly expressed using some given reference framework.
II. A natural sequence for carrying out the work, and that the sequence can be mapped to a timeline.

In the paper[4], this is discussed for project-based learning in an engineering education setting and using the CDIO Syllabus as reference when formulating the ILOs. Also, in the paper the project-based learning activities are carried out using a so-called project model named LIPS. However, the aim of the example is to focus on the general aspects, and for illustration purposes some examples will be given, and some comparisons will be made.

ILOs

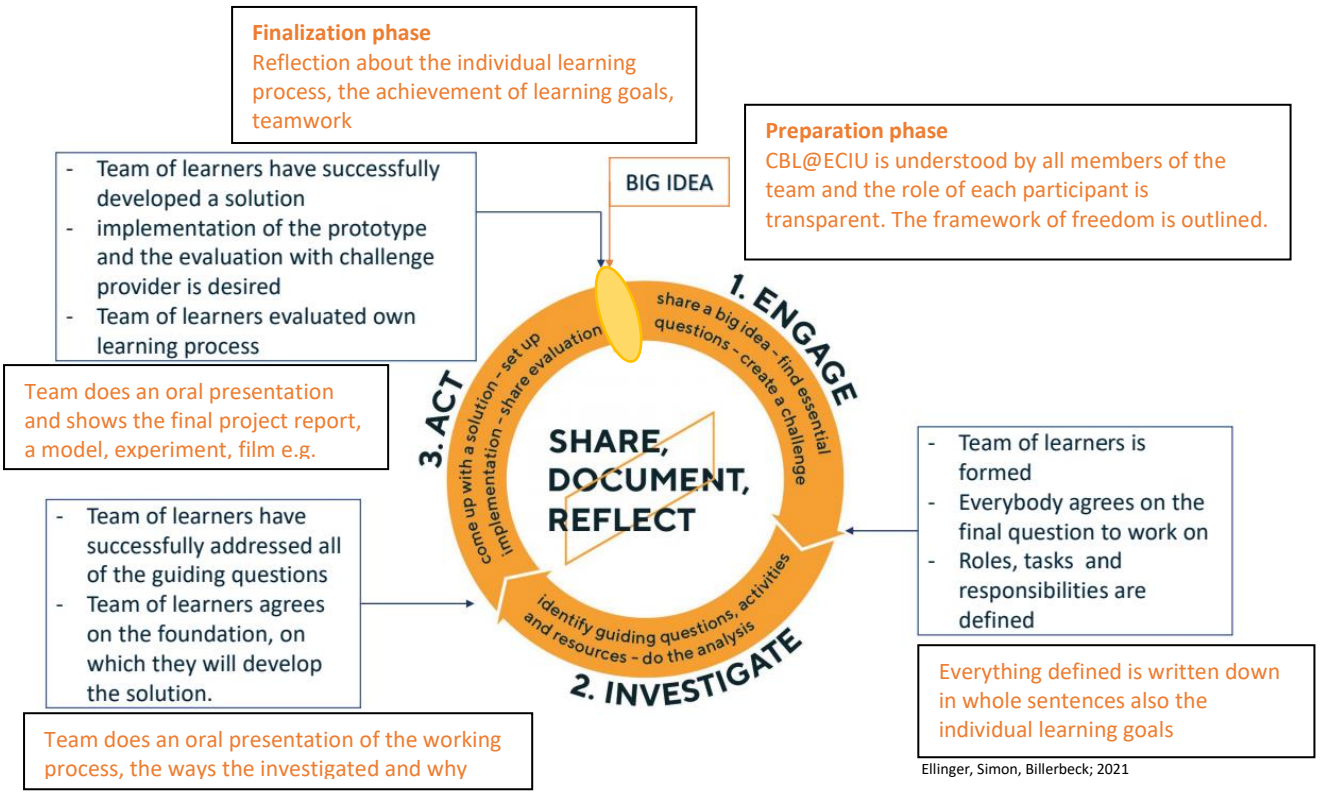
The intended learning outcomes for a course or an entire education program can be formulated in different ways and using different reference frameworks. The 21st Century skills is one alternative, the CDIO Syllabus is a second one, the Generic competences proposed by the so-called Tuning project, a third one, etc, and the components of these frameworks can be mapped back and forth. The paper[5] uses the CDIO Syllabus, with subsections about e.g. personal and interpersonal skills, communication, etc, but this just one alternative and this is not important for the message of this example. Hence, for the section below it is assumed that a set of ILOs has been formulated and that the assessment of these ILOs is desired.

Sequence and timeline

CBL is based on the three steps Engage-Investigate-Act, which starts from a *Big idea* and will lead to a result of some type. For the execution of the CBL activity the sequence is mapped to a timeline. As a comparison the CDIO framework is based on the sequence Conceive-Design-Implement-Operate, which starts from an idea or a need, and will lead to an engineering solution in operation. There are both differences and similarities between these sequences, but in both cases, they can be translated to a timeline. In the paper[5] it is then discussed how the CDIO sequence can be implemented in project-based learning using a project model based on three phases *Before-During-After*, also tightly connected to a timeline, will well defined *checkpoints* between the different phases. Additional checkpoints (*tollgates and milestones*) can be used along the timeline depending on the context. The important thing to note is that these checkpoints can be used to various types of assessment activities, including written documentation, pitches or other oral presentations, reflections, etc. The paper presents just one example of how this can be done. The important thing is that that the use of the checkpoints enables *continuous assessment, feedback, and reflection*, which is desirable for the learning process. Finally, there is no clear definition of how a Big idea should be formulated in a

[4] USING A PROJECT MODEL FOR ASSESSMENT OF CDIO SKILLS by T. Svensson and S. Gunnarsson, Department of Electrical Engineering, Linköping University, SE-58183 Linköping, Sweden; svante.gunnarsson@liu.se

desired way in CBL, but as a comparison it can be noted that the starting point using the project model in [5] is a *project directive*, which is a fairly vague description what is desired or asked for. Based on that it is the task for the students to, via questions and investigations of different kind, develop a more concrete description of the task. In that sense, i.e. for generating questions, it serves a somewhat similar purpose as the Big idea.



Ellinger, Simon, Billerbeck; 2021

1. *What are the core characteristics of the example?*

That the use of a structured work process with continuous, e.g. on a weekly basis, process for follow-up and evaluation is very useful for assessing several relevant skills.

2. *Why is this example useful for making CBL work in curricular settings?*

To have a common work process, including roles, check-points, information flow etc., gives a common language and understanding, and last but not least continuous evaluation, feedback, and assessment.

3. *What do you need to consider when planning to use it?*

You have to realize the value in using a structured work process.

Appendix 4

Different forms of rubrics for different assessment tasks

Example for giving feedback

	Good is	What can be improved?
Planning their work		

Example of rubric, mostly use for assessment only.

	Insufficient	Sufficient	Good	Excellent
Planning their work	No clear overview of activities, milestones or division of tasks.	Basic overview of most activities, milestones and task division. Some minor adaptation of planning when the situation changed a lot.	Clear planning with an overview of all relevant activities, milestones and task divisions. Planning was adapted when the situation changed and/or things went different than originally planned.	Very elaborate planning with all activities and milestones included, including task division. Alternative scenarios were given as well. Planning was adapted in advance, to prevent things going wrong.

Example of Single Point Rubric; can be used to give feedback and assess at the same time.

	What can be improved	Standard level	What exceeds standard level
Planning their work		The students made a clear planning with an overview of activities, milestones and task division. Planning was adapted when necessary.	