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Authors:
Charlotte Oude Alink
Hans van den Berg

Preamble:
Starting from the 1st of September 2013 the University of Twente (UT) will introduce the Twents Educational Model (TEM) in the bachelor programmes. One of the aspects that will be new in the curriculum is project-led education (PLE) will be introduced.
During an inspiration day for the Educational Services (Onderwijskundige Dienst in Dutch) PLE has been discussed. This document has been written for this department to shed some light on this topic and give some additional explanations. PLE is a very unknown concept; but it is comparable to project-based learning. Most of the literature used in this document is about project-based learning; but transferrable to PLE.

Project-Led Education (PLE)

The Twents Educational Model (TEM) is our response to the broadly, internationally, identified need to change Higher Education (HE) since the 1970's. The first reason to change are the students; they are changing as well as the way the students learn. UT realized this and wanted to adjust their educational model so they can meet the needs of the new students. A second reason is the changing society and the rapid change in jobs and job requirements that is taking place in our society right now. It can no longer be assumed that students will find a lifetime job and continue working for their entire career in the discipline that they graduated from or even that their future jobs already exist. Today we see it as our obligation to properly prepare our students specifically for this rapidly changing world in which we live.
So our study programmes have to prepare students for a broader perspective. Through the TEM our students will learn to become what we call T-shaped professionals (University of Twente, 2013). Our students will learn their own discipline in sufficient depth and will also become professionals who can critically reflect on this knowledge, connect it to other disciplines and the society as a whole.
To learn students to become T-shaped professionals the TEM stimulates and promotes students to become active learners. Project-led education will be used as one of the key methods to achieve this. When students participate in projects they will develop competencies and skills to work in an ever changing world (e.g. Moesby, 2002).
By introducing project-led education we hope to create more deep learning, which means learning for understanding (Beattie, Collins, & McInnes, 1997). As opposite to surface learning; where students know the knowledge, but don't understand it in a way that they can use it in a different context. When students are engaged in deep learning they will also learn how to use the knowledge in different contexts (Biggs, 1987). The UT strives for deeper understanding and deeper learning; so students become the T-shaped professionals as describes before.

The term 'project-led education' is very broad. It can be interpreted and explained in many ways. In the TEM variations in the projects will also occur. This will depend on the discipline, module design, and position in the curriculum. Based upon a number of typical characteristics we will explain our approach for project-led education and how project-led education is considered to be a key success factor of the TEM. How these characteristics are connected to each other is shown in figure 1.

Before we dive into the different characteristics of the project-led education approach that we will adapt on the UT, another aspect of the TEM has to be discussed. Namely that the TEM is a form of modular education (University of Twente, 2013). This means that our programmes will be shaped using modules. The three years of all of our bachelor programmes will consist of 12 modules. These modules will have a size of 15 ECs, and the projects that take place in the TEM will be parts of the modules. A project isn't mandatory in a module, but we do strive for a project in every module.
Every programme year will consist of four modules; the first six modules will form the base or core of the programme. For the 7th and 8th module students will have a conditional free choice, which means that students can decide for themselves which module they want to follow as long as it is related to their own discipline. The 9th and 10th module the students will have an unconditioned free choice; during these two modules the students can also choose to follow modules that aren't related to their own discipline. The final two modules will be combined. During these modules the students will finish their programmes by doing a closing assignment. This can be a research project, a (design) project, etc. Some programmes will not have a final assignment that consists of 30 EC; in this case the final assignment will be adjoined by other elements like extra training in research skills or extra in-depth knowledge to prepare the students for their master programmes even better.
Every module can be compared with a mini programme (University of Twente, 2013). Each module will have one final grade, so students can only pass the module as a whole.

Back to project-led education. In the TEM we strive for the integration of the different parts of the module, so the students will see the module as a whole package and can relate the different subjects of the module to each other. Most of the time this will happen during the project. So the project is a very important aspect of the module. But what do we mean by the term project? In TEM we see a project as an activity in which a group of students collaborate to develop and apply new knowledge, skills and attitudes by solving a (design) problem within a set boundaries and conditions. How strict these boundaries and conditions are depends on various aspects that will be addressed below.

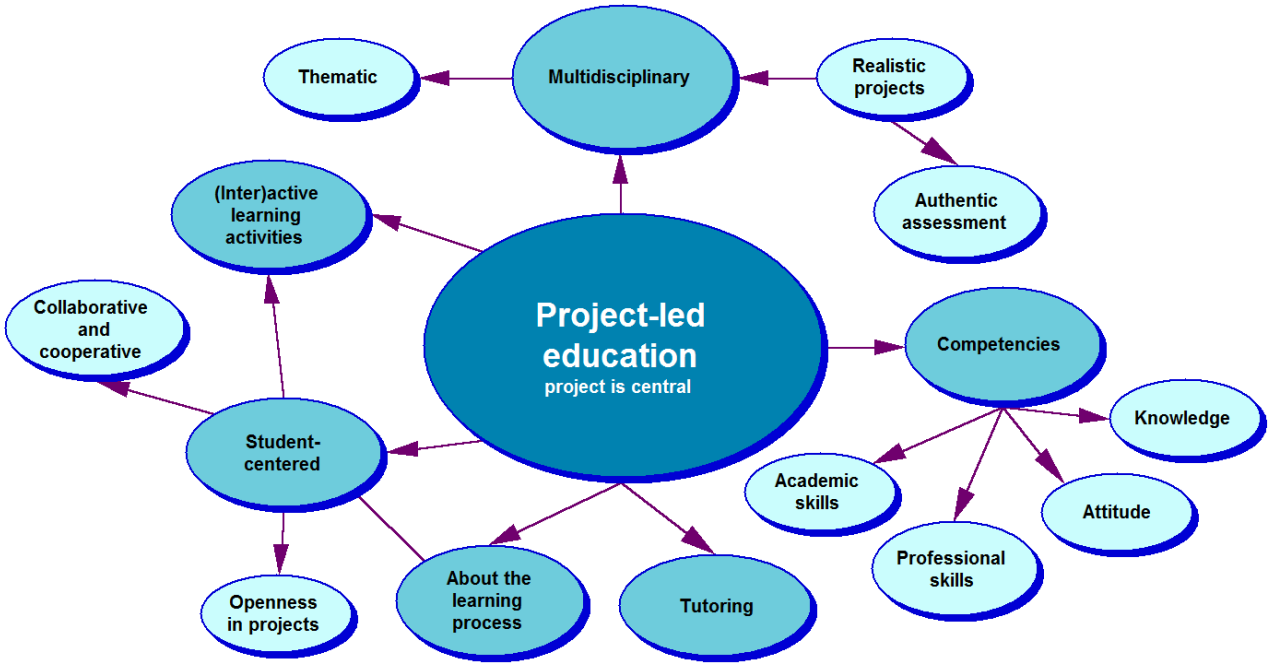

Figure 1. Features of project-led education

These features are key characteristics for the type of project-led education in the TEM and they are explained below.

1. Project is central

   In project-led education the project is central and leading (Kolmos, 2009; Thomas, 2000) in the modules. When working with the TEM, project-led education can be used as an instrument to achieve active learning and a way to learn knowledge (University of Twente, 2013). This does not mean that having a lecture in a module is out of the question. During the design of the module, the designers have to decide which form of teaching fits the learning goals best (University of Twente, 2013). In the adjoined parts of the module knowledge and skills can be learned, that support the project (Mills & Treagust, 2003). During the project the knowledge, skills and attitude can be applied and enlarged. So students can also gain new knowledge, skills and attitude by working in the projects. The position of the project within a module depends on the design and discipline of the module, and its learning goals.

   An example of a design of a module with adjoined parts of the module is given in figure 2. The three adjoined parts of the module are supportive of or integrated into the project[1].

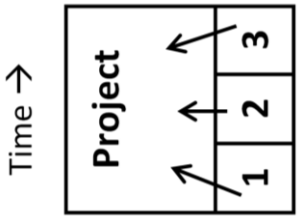

Figure 2. Adjoined parts of the module support the project.

   An example of a module design with a project parallel to the other part of the module is the EPA Module 1.1. (Groenendijk, 2013). The design of this module has the same design as the module in figure 2. During this module, all the adjoined parts are necessary to complete the project work. The adjoined parts will still be assessed separately, but the project is the leading component in the design.

2. Openness in projects

   Projects in project-led education can differ in their designs and implementation; there is a range from 'closed' to 'open' projects. When a project is open, the teacher nor tutors know how the final product should look like. The final solutions of the student groups can (and preferably will) differ from one group to another. A closed project has a 'right' answer; teachers and tutors know what the final product should look like. Because of this, closed projects are easier to facilitate and check.

   The design should fit the purpose and position of the project in the programme. The purpose of a project can be seen as a 'teaser' or 'closer' of a module. These types of projects are merely used to activate students, not to learn new knowledge. But a final goal in the TEM is

[1] Next to the project and adjoined parts of the module, parallel course lines can be offered. Examples are the math – and methodology line. These course lines are a continuous factor throughout the entire curriculum. If possible, some assignments of the course lines could be integrated within the project, but this will probably be an exception.

that projects are used to learn new (theoretical) knowledge, skills and professional attitudes. So projects can be used as a 'teaser' of 'closer', but this should be the exception, not the rule. Another aspect that should influence the design is the position of the project in the curriculum. The design of a project in module two most likely is different compared to the design of a project in module six. This has to do with the complexity of the project in relationship with the progression of student learning in the programme. An open project is more complex than a closed project, so open projects might be better suited later in the programme. At Aalborg University (AAU) for example, students have a basic year in which they gradually learn the skills to become more independent in project work (Moesby, 2002). They start with closed projects and the projects in the following years gradually become more open. Kolmos (1996) categorizes the projects at AAU into three types of projects; assignment projects, subject projects and problem projects. The assignment projects are quite structured (in the way that we describe as 'closed') and used as a warm-up to prepare students to become more independent and self-reliant in later projects. The subject projects are somewhat in between structured and open and the problem project are open. This means that the students are responsible themselves (for defining the project as well as coming up with a solution for it). In figure 3 below, the three different types of projects are placed in a two by two framework to visualize the difference in the starting point en initiative of the three projects[2]. It shows that the problem project starts with a problem en is very student driven. The assignment project is more closed en has a subject as a starting point and is very teacher driven.

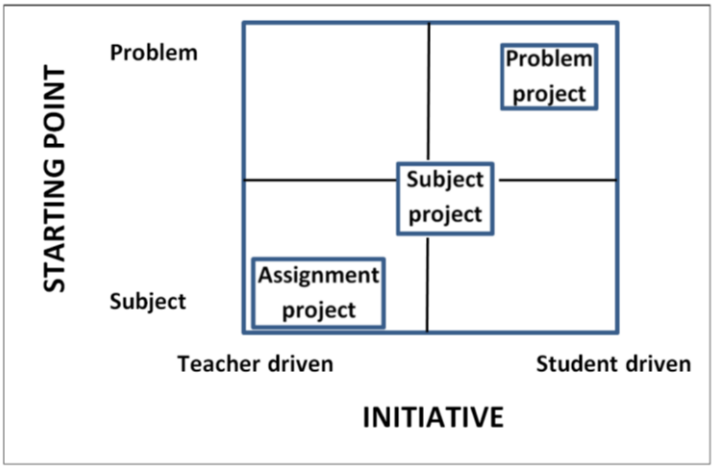

Figure 3. The visualization of the different starting points and initiative of the three types of projects at AAU (Van den Berg, 2012).

Closed projects can give students (and teachers!) some time to get used to the idea of project-led education and shift from teacher-centred learning to student-centred learning. Because this subject is so closely related to student-centeredness, it will be further addressed in feature number three 'student-centeredness in projects'.

3. Student-centeredness in projects

   One of the important aspects in the TEM is the fact that we strive for student-centeredness. Students should learn how to be independent and responsible for their own learning.

[2] The projects at the UT may also differ in openness in projects, but these projects aren't categorised like the projects of AAU. Therefor it is more difficult to make a visualisation like figure 3, but we are working on a TEM cube; it will be shown in a later version.

Teachers who teach with a student-centred approach are more likely to realize deep learning (Gibbs & Coffey, 2004). In the TEM, project-led education is one of the instruments to achieve this. The openness of the project is related to the student-centeredness of projects. When a project is more open, usually it is more student-centred; the students have more influence on their learning. Open projects also tend to be more motivating to students.
An open project is more difficult for the students, but also for the teachers and tutors to facilitate. Teachers have to 'let go' and trust their students in their eagerness to learn and do the 'right thing'. Students will have more responsibility and will need to develop a professional attitude towards learning.
When students start with the programme they will probably react hesitant to accept this influence, but when they get used to it, it can motivate and activate them (e.g. Weimer, 2002). So in most cases open projects are not suitable for the beginning of a programme. Open and more influential projects are more of an advanced stage of student-centred learning than closed projects.
The teacher can give students influence in different areas of the project. The following four areas will be discussed in somewhat more detail.

- Students' influence on content;
- Students' influence on scheduling;
- Students' influence choice on learning activities;
- Students' influence on types and frequency of assessment.

Content

When students influence the content, they can have a say in the subjects that are discussed, the order in which they are addressed, the amount of time that is addressed on certain subjects, etc. According to Weimer (2002) it is very difficult for teachers to let go of the control of content. They want to cover all of the materials they think are important and thereby possibly overflow their courses and lectures with theoretical knowledge and lose out on interaction and active learning, or in other words undermining the student-centeredness that we strive for. This may demotivate the students and diminish their training. Giving students a certain influence in the content can activate them to become more motivated. Within the TEM, influence on the content could be given in the projects. Teachers could for example let students decide what the subject of their project is. Moesby (2002) says that 'Ownership of the project work is a very important motivating factor for the student who is learning about the project environment.'(p. 150).

Scheduling

Another thing in which students can be given influence is scheduling. When giving more influence in this area, students can decide for themselves when and where they study. Some students study best late at night, some early in the morning. When strictly scheduling all of the courses and project work, the preferences of the individual students can't be honoured. If teachers are more flexible with their rosters students can study when they are at their best. This flexibility could for example be achieved by using video lectures instead of physical lectures, schedule consult hours in which students can choose to participate or not (this could be done online as well), let students plan their own project and set their own deadlines, etc.

Learning activities

The third area students can be given an influence in are the learning activities. The amount of influence a student receives about the learning activities can vary (Weimer, 2002). This gives a possibility for students (and teachers) to get used to the idea. According to Weimer (2002) students can be willing to work harder for a course in which they have a say in the activities and assignments they need to complete for this course.

Assessment

The last item on the list is the influence students can have on assessment. Usually teachers are very strict about assessment. But when students receive more influence in assessment, it can contribute to their learning process (Weimer, 2002). For example teachers can have students produce exam questions; to come up with a good question, students need to have a good understanding of the subject matter. Another example is the form of assessment. Do the students need to hand in a paper, do a test, hold a presentation or can they decide this themselves?

And important issue to take into account is that most students aren't used to having much influence regarding their learning (Kolmos et al., 2007). Because of this, the projects at the start of the programme have to be designed in such a way that the teacher can guide the students, and will prepare the students for more independent work. If students can influence lots of aspects from the start, they might get scared and frustrated (Kolmos et al., 2007) 2007; Weimer, 2002).

It will become more complex for students, teachers and tutors and also more challenging. In the TEM the modules (and thus the projects) are designed bottom-up. This means that teachers are free in the module and project design to use or ignore these possibilities to make their programme more student-centred. The ultimate form of project-led education and student-centred learning within the TEM isn't fully defined. Based on experiences in the coming years the ultimate forms of project led education within the TEM will become clear. In the next characteristic that we will describe hereafter a few of the existing variations of project-led education will be addressed.

4. Variations in project-led education

Project-led education is another name for project-based learning which is a widely used term and used in many different ways (Hanney & Savin-Baden, 2013; Thomas, 2000). Thomas (2000) adds to this that in some articles the term problem-based learning is used, but project-led education is described. So it is very easy to get confused when trying to define project-led education. As a consequence; there are lots of different designs for projects. According to Thomas (2000) a 'project' that is very structured and guided isn't project-led education, but problem-based learning or a combination of both. Weenk and van der Blij (2012) state that the fundamentals of project-led education and problem-based learning are the same, because 'both are authentic, constructivist approaches to learning.' (p. 42). A combination of project-led education and problem-based learning can be very effective; Mills and Treagust (2003) even suggest this combination. At AAU the programmes could be defined as a combination of both problem-based learning and project-led work. However Kolmos (1996) describes the programmes of the AAU as problem-based, she combines it with

project work. The problems are answered during project work in which the projects can take different forms; like the three different types of project described before in the paragraph about the openness of projects. So the AAU model is a combination of problem-based learning and project-led education.
Kolmos (2009) compares the approach of the AAU with the approach used at the University of Maastricht (UM). Although Kolmos (2009) uses the term problem-based learning (which she also uses to describe the approach on AAU) for the approach of UM, the problems in the UM approach are very different. In the UM approach, problems are solved in a structured manner with a set plan to solve the problems. The process in which the students solve the problems consists of seven set steps (known as 'de zevensprong' in Dutch). So what we see here is that problem-based learning (just as project-led education) can differ a lot.
In figure 4 an attempt has been made to visualise the differences between and within the various approaches. The figure shows how the combination of different foci can create different approaches. For example, if the focus is on the process and on content this can be utilized in a traditional course. An example of the combination of projects and problems is the approach used at AAU. At UM you see a combination of problems and the process, the process are the seven set steps that the students have to follow to solve the problem.

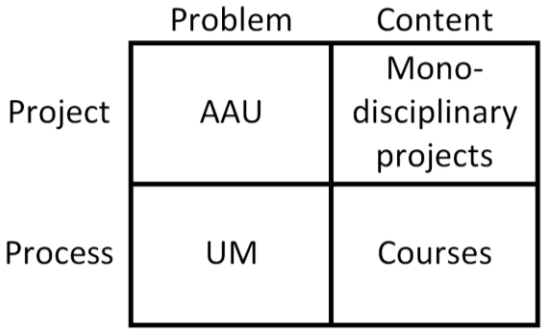

Figure 4. Visualisation of the different approaches in project-led education and problem-based learning.

The TEM is based on a few principles, and project-led education is an instrument to meet these principles (Mulder, 2013). The use of project-led education should be maximised, but the form can differ based on the subject, discipline (Mulder, 2013) and the purpose and position of the module in the 3-year bachelor programme.

5. Collaborative and cooperative

A project can (and within the TEM: will be) used as an instrument to work collaboratively as well as cooperatively (Kolmos, 2009). When students collaborate they all strive for the same goal (Prince, 2004). When students cooperate they don't have to strive for the same goal but it is important that students work together (Prince, 2004). Cooperative learning is based on the idea that students can work more effectively when they cooperate instead of competing with each other (Hattie, 2009).
In both of the approaches students work together, but one of the differences is that students who work collaboratively are assessed together; which theoretically means that all the students receive the same grade. When students cooperate they will be assessed individually, not all of the students receive the same grade (Prince, 2004). This means that when students cooperate, they can be held responsible for their part of the project and it will only affect that specific student. In collaborative work, the work of one student can affect all

of the other students' grades. Figure 5 shows an abstract image of the differences between the collaborative and cooperative approach. In collaborative work, the students are all working within the same project and have the same end results. In cooperative work, the student work together in the same project but also have individual responsibilities that they work on outside the project.

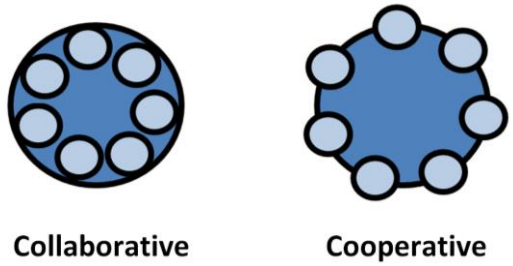

Figure 5. the difference between collaborative and cooperative

The projects in the TEM will probably be combinations of both approaches, students will probably be assessed in groups as well as individually. An advantage of the combination is that you 'force' students to work together, but you still can hold them accountable for an individual part. This prevents (a part of) the issue that one student takes credit for the other students' work.

An example can be seen in the design of module 1.2 of CW (Karreman & John Sevens, 2013); during the project in this design students will be assessed on individual assignments such as interviewing and analysing. But they also will be assessed as group for assignments such as the final presentation and report.

6. Multidisciplinary

One of the reasons to work in groups is the collaboration between the students; they can be motivated and learn from each other. But when students of the same specialization collaborate, the pitfall might be that students divide the work and still work in parallel and independently from each other (Fong, 2003). This is the opposite of what you want to achieve in project-led education. A solution for this problem could be to have true multidisciplinary projects. Students work multidisciplinary when students from different disciplines work together on a common problem (Huibers, Luitwieler, Martinot, & Meijers, 2012). Fong (2003) says that 'project team members of differing knowledge domains [*are*] more likely to discuss their uniquely distinct information and knowledge than those who possess information in common.' (p. 483).

Another advantage of multidisciplinary projects is that students can learn how to integrate the different disciplines to each other. This broadens their view and can help them to become the T-shaped professional which is an import goal in the TEM. According to Biggs (1987) interrelating knowledge with each other helps to profound deep learning.

So within the TEM programmes are stimulated (not obligated!) to work multidisciplinary. This can be achieved at different levels, two of which will be explained.

One is on a small scale, within one programme and the second one is on al larger scale, between different programmes. In the design for module 1.4 of EE (Abelmann, van Damme, de Jong, Krijnen, & Olthuis, 2013), all of the subjects are integrated within the project; there are no adjoining parts of the module. Different domain from EE are integrated with each other during the project, as shown in figure 6.

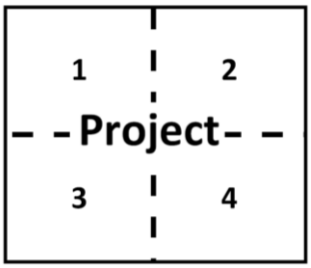

Figure 6. Integration of the different domains of one programme within the project.

An example of a design that shows multidisciplinary work between different programmes is the design of module 1.2 from ST, TN and AT (Ter Brake, 2013). These three programmes have an integrated project, were students from the different disciplines work together. In the project students are clustered based on their discipline, so they have different fields of expertise in every project group. An example of a design like this is show in figure 7.

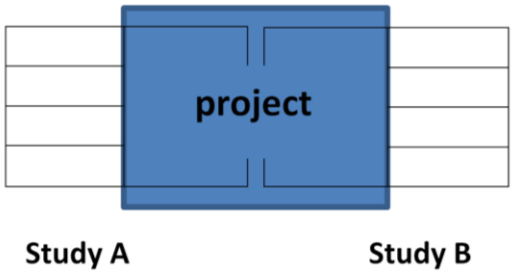

Figure 7. Students from different programmes work interdisciplinary within one project.

In module 1.2 of ST, TN and AT (Ter Brake, 2013) there are adjoined parts of the module of which some are offered separately per programme and some modules are spread over the different programmes and taught together.
Mills and Treagust (2003) point out that the size of the project has an effect on the possibility to work multidisciplinary. They say it's easier to work with different disciplines in a larger project.

7. Realistic projects

According to Prince and Felder (2007) the lack of connection of the theoretical content to the real world is a continuing factor for science students to quit their programmes. When working in projects there is a big opportunity to create realistic learning experiences. The assignments become meaningful for the students; which can motivate them. When students are more motivated their eagerness to learn in intrinsic; this enlarges the possibility for deep learning (Biggs, 1987). The context of the projects can be derived from the fields of the students' future jobs. As Fong (2003) says: 'Learning must be integrated with current tasks, not only to meet present goals, but also to develop and retain knowledge for future organisational needs.' (p. 480). Thomas (2000) and Weenk and van der Blij (2012) say that projects are based on a realistic, complex tasks or problems that motivate students to get in touch with concepts, principles and disciplines of their own field of work. Because of the connection between the concepts and disciplines that are introduced during the projects, students will get a better picture of what is expected of them when they start working (Mills & Treagust, 2003; Perrenet, Bouhuijs, & Smits, 2000; Weenk & van der Blij, 2012). By working together on problems from the 'real world' (figure 8) students can prepare themselves

better; this may give them an advantage when they start looking for a job. The real world can be introduced into the projects by the use of 'challenges'. During a challenge students work on an assignment that originates from cases in the society. These challenges could be handed in by companies or by students themselves. This could result in students working on realistic problems and teachers spending less time on designing the projects because they don't have to come up with different ideas and contexts for the projects themselves.

Figure 8. Working on a realistic task form the real world.

Within the TEM working in realistic tasks is very important. Even before the TEM the connection with the real world was an important characteristic of the educational model of the UT. This is because of the High Tech Human Touch (HTHT) character of the UT, which is an ingredient of the educational signature of the UT (Mulder, 2013). An aspect of the HTHT character is that technical subjects get connected to a problem or a context of the 'real' world, so theoretical knowledge becomes meaningful for practical problems. Perrenet et al. (2000) do, however, mention that working in realistic projects takes more time because of contextualising.

8. Authentic assessment

   Having realistic projects is an opportunity to have authentic assessment (Eddy & Lawrence, 2012). Eddy and Lawrence (2012) say that 'authentic assessment provides an opportunity for deeper analysis and evaluation of student learning. ' (p. 1). Weimer (2002) agrees with this; she states that assessment can be a way to grade, but also to learn. Learning for a grade suites surface learning, but learning (and assessing) for understanding fits with deeper learning. Traditional assessment usually only assesses knowledge, while the more complex learning isn't addressed (Libman, 2010). In traditional tests students often learn for a grade instead of learning to gain knowledge (Weimer, 2002).

   This obviously is not the goal of a learning facility; the UT wants students to learn and remember and be able to use what they've learned. At the UT, students will be prepared to become T-shaped professionals. This means that they will not only gain knowledge in the depth of their own discipline, but will also become graduates that have the skills and attitude to connect their knowledge with other disciplines and the society. To reach this, a deeper kind of knowledge is necessary, in which authentic assessment can play a role.

9. (Inter)active learning activities

   Active learning activities often are more effective to stimulate the learning process than traditional (passive) learning activities (Prince, 2004). In active learning activities students actively gain knowledge instead of passively receiving knowledge by reading a book or listening to a teacher (Weimer, 2002). Knowledge can't passively be handed over, knowledge has to be actively acquired so students will get motivated to develop themselves (Weimer,

2002). Incorporating active learning activities can make the difference between surface and deep learning. The teacher should support the students to learn and reach his and the programme's goals (figure 9).

Figure 9. Teacher supports students to gain more knowledge

According to Prince (2004) the manner that active learning activities are offered have an effect on the outcome of these activities. Especially engineering faculties have to pay attention to the manner they incorporate these activities; they often implement them in the wrong way (Prince, 2004). So we have to give extra support and provide examples for our many engineering programmes.

Within the TEM, teachers are stimulated to use active learning activities. The use of traditional activities like lectures may become less; which doesn't mean that they will disappear completely. These activating activities can be done during lectures, but also outside of the lectures students can be activated. O'Neill and McMahon (2005) give a couple of examples (Table 1), which show student-centred learning activities that can be addressed in and outside of the lectures (O'Neill & McMahon, 2005).

Table 1. student-centred learning activities for in and outside of the lectures (O'Neill & McMahon, 2005).

Outside of the lecture format	In the Lecture
Independent projects	Buzz groups (short discussion in twos)
Group discussion	Pyramids/snowballing (Buzz groups continuing the discussion into larger groups)
Peer mentoring of other students	Cross-overs (mixing students into groups by letter/number allocations)
Debates	Rounds (giving turns to individual students to talk)
Field-trips	Quizes
Practicals	Writing reflections on learning (3/4 minutes)
Reflective diaries, learning journals	Student class presentations
Computer assisted learning	Role play
Choice in subjects for study/projects	Poster presentations
Writing newspaper article	Students producing mind maps in class
Portfolio development	

Another possible way to teach more actively is to incorporate ICT. The use of ICT can also help to make projects more realistic, which can activate the students even more.
Examples of module designs that include ICT are designs of module 1.2 of IBA (Bos-Nehles et al., 2013) and 1.3 of PSY (Noordzij et al., 2013). In the design of the IBA module a educative serious game is used; students have to save a company that is going under. In the design of the PSY module students use ZAP's for simulations. ZAP stands for Zeer Active Psychologie; which means Very Active Psychology. ZAP's are interactive ICT based assignments in which different psychological themes are addressed. In a ZAP the students can find an introduction, an explanation about the simulation and the theory used during the simulation.

10. Learning process

    Teachers in higher education often offer too much (theoretical) content during their lectures (Mills & Treagust, 2003; Weimer, 2002). They want to cover all of the content during their lectures (Mills & Treagust, 2003; Weimer, 2002), while students could also study most of this content independently from their textbooks (provided that these are equipped with assignments, test, etc.). Because of this the teacher has little time to employ (inter)active learning activities that can enhance and stimulate the learning of students much better than the relative passiveness of a lecture. Kolmos (2009) states that 'PBL [*project-based learning*] is about learning and motivation for learning by the use of more student-centred learning principles rather than only scientific content principles' (p. 278). In project-led education the focus may be less on content and more on the learning process, this depends on the learning objective of the project.
    But there is a pitfall; a real threat for projects is that the project work is so open that there is no student focus on content whatsoever and that little attention is paid to the learning process (Hanney & Savin-Baden, 2013). Project management can be a learning objective of a project and take up a lot of time. But even when this isn't an objective; it can still take up a lot of time that could be spend differently. So when designing a project, this has to be taken into account.
    By introducing the TEM, the UT's goal is to shift the focus from teaching to learning. The learning process should become more important than covering all of the content in e.g. a lecture. For the TEM an evaluation model has been developed that can visualize the maturation of the teachers' and students' learning processes. This model is called the Maturity Model (MM). The model does not say anything about what content is taught in the modules or which learning goals should be met. It connects the development of the teacher in becoming more student-centred to the level of development of the students. Both of these learning processes are important for the success of the TEM; and are therefore important to discuss, to evaluate and monitor.

11. Role of the teacher

    Within the TEM, different types of educational meetings will exist, like lectures, practical's, tutorials etcetera. In the different educational meetings teachers will have to adopt different types of roles. The teachers will not only fulfil the traditional role of instructor, but also the roles as a mentor or tutor. It's possible that the same teacher will have to adopt different roles within one module; sometimes he will be the lecturer and other times the tutor.

The role of a tutor will be new for most teachers, and can differ between the programmes. The description following below is general and some programmes may only adapt a few of the tutors' tasks. The tutor role used during the tutorials in the projects and within the project the tutor will have four tasks; monitoring, critical reflection, expertise and supporting collaboration between students (Human Resourses, 2013).
The tutor will monitor the progress of the project, but he may let the students in the lead. The students and tutors will discuss the progress and the approach that the students have chosen. He will keep a close eye on the progress of the students and can give a few pointers when students get stuck (Human Resourses, 2013). This way the tutor can make sure that the students will make enough progress to make all of their deadlines and hand in their final product in time. While at the same time managing the student development process to more independence.
To make sure that the students will achieve the end goals of a project the tutor will also have the role of a critical reflector (Human Resourses, 2013). He will continually ask the students why they made certain decisions and stimulate them to reflect on their own work. This will give the students insight in their actions and help them come up with new ideas and approaches.
Of course students can also contact the tutor if they have any questions of their own. If the questions are related to the process, the tutor can help immediately. If the students have questions regarding the content a tutor can refer them to an expert or if he is an expert, he can help the students himself. But some in some programmes the tutor will only guide the process and will not be a disciplinary expert. In other programmes the role of a tutor can change in later years of the programme (Van den Berg & Steens, 2013). For example in the programme of BMT; tutors will only have a process guiding role in the first year of the programme; in later years the tutors will also need to be experts. During one of the interviews in the evaluation of the pilot module the interviewee said that in the later years; tutors will need to be experts otherwise they will not be able to help the students with their problems. According to this person, the problems will get too complex to guide if the tutors don't have expertise about the specific domain.
When the tutor is an expert himself, he will still have a different role than a traditional lecturer. As a (tutor) expert, the tutor will coach the students in the right direction. He will ask questions and maybe give tips about where they can find the information. The tutor will not merely hand the information over, but will point the students into the direction and let them find the information themselves.
The fourth aspect of the tutor's job is to help the students in their collaboration (Human Resourses, 2013). Working in groups will also be a new experience for some of students. To make sure that this process will go well and students are really collaborating and not just depend on one or two strong members of the group, the tutor will monitor and guide the group. The students in the group will also have a responsibility for themselves to come forward if there are any problems.
A final note about the tutor is about what he isn't. The tutor is <u>not</u> an advisor when it comes to personal issues or individual study issues (Human Resourses, 2013). The tutor can refer the student to the appropriate person i.e. a study advisor who can refer to a student psychologist.

12. Thematic modules

When working with thematic modules the different parts of the module should be designed with a common theme in mind. This makes it easier to integrate different disciplines within or between programmes. The dark blue frames in figure 10 show how the different parts of the module can be combined by a theme. The rows represent the traditional design of a curriculum, the blue frames show which parts are connected by a common theme. When cells from different modules have a common colour, it means that the same course line is addressed; but the theme is different.

By combining the different parts by a theme, it's easier to create a project that includes the different disciplines, which opens up the possibilities for project-led education.

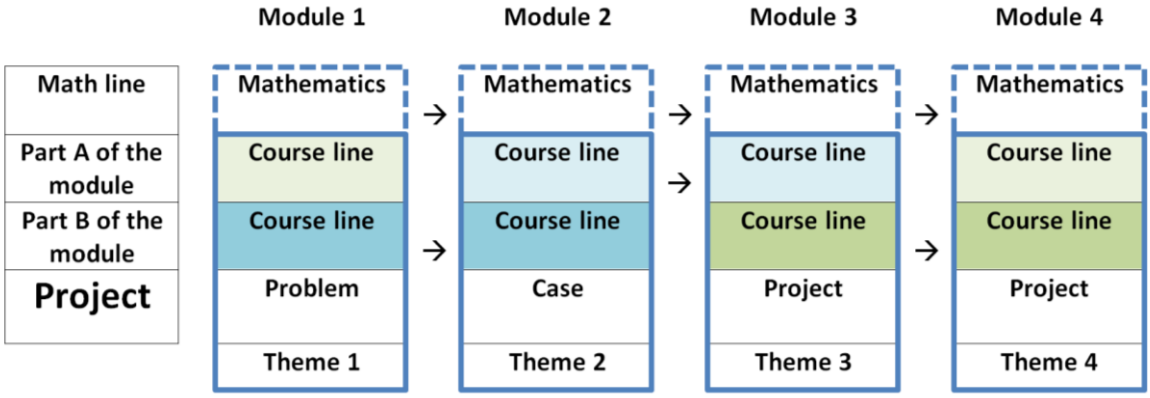

Figure 10. Example of working in themes.

In the TEM we no longer speak of individual courses, but of different parts of the module. These different parts of the module can be based on a former course (but should not be a copy), a combination of 'old' courses or can be designed from scratch. The parts (including the project) are connected with each other by a common theme, so students can detect relations between the different parts of the module. An example is the sport theme of the first module. In most modules designs the projects have a subject that is related to sport, for example the BIT module 1.1 (C.P. & C.M.M., 2013) in which students are designing an app for the yearly sport event the 'Batavierenrace'. In the adjoined parts of the module, the students will learn the technique of designing an app.

The math line can partially be connected to the theme (visualized by the dotted frame). This means that within TEM the mathematical line will be connected to the theme if possible, but this mostly will not be the case. The math line may be taught to students from different programmes simultaneously. Because of this; it's possible that students who work in different themes will come together.

In the TEM, the first module of every programme has the same theme, in the first year the theme will be 'sport'. This module will have a large end conference where the students can present and share their work. It is up to the module teams to determine the theme for the following modules.

13. Competencies

Van der Blij (2002) defines a competency as 'The ability to apply integrated complex knowledge, skills and attitude in such a way that the person acts responsibly and adequately in a certain context.' (p. 1). Meijers, van Overveld, and Perrenet (2005) describe seven

different areas of competencies (figure 11) that show the characteristics of a good academic. These so called Meijers criteria were drafted for and accepted by the three technical universities in the Netherlands (TU Delft, TU/e and UT). The Meijers criteria have been written to establish a firm baseline for academic competencies for the three technical universities (Meijers et al., 2005).

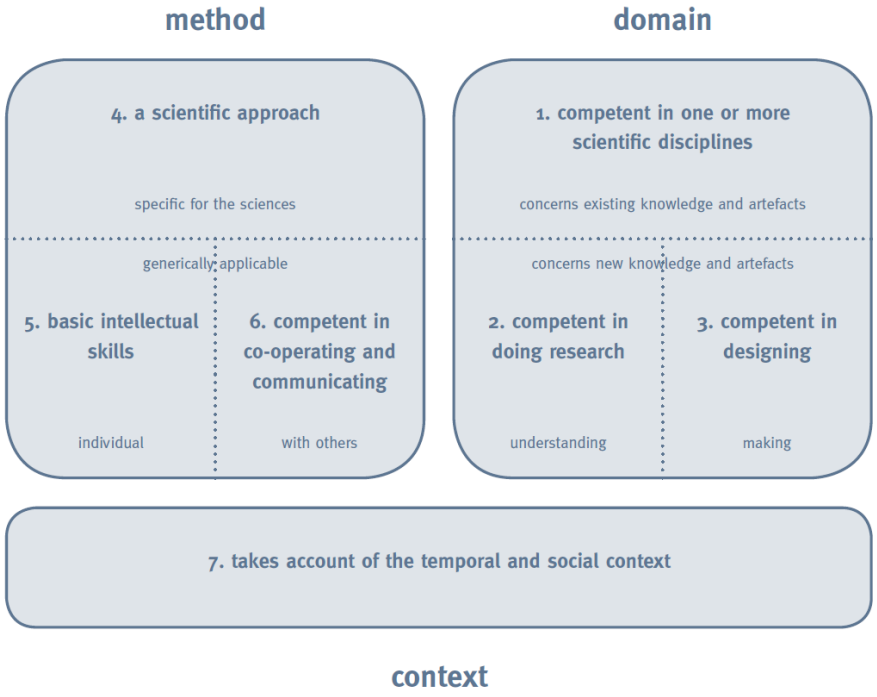

Figure 11. Seven areas of competencies of Meijers.

Based on these areas of competencies, learning objectives can be formulated. These areas of competencies are equal for all of the degree programmes, but the conversion of these areas into learning objectives depends on the programme.
The academic skills are located under methods (competency area 4, 5 and 6).

14. Academic skills

An important aspect of studying in an academic programme is to gain academic skills. Vreman and Slotman (2011) say that 'the term academic skills is used for skills that describe the critical attitude of university students' (p.5). According to Oosterhuis (verbal communication, June 14th 2013), when working in projects, academic skills should be addressed just-in-time. This means that when students need to conduct an interview, they need training in interviewing, when students need to analyse, they need training in analysing. The skills are addressed right before the student needs them. Mills and Treagust (2003) state that skills like time management and searching for literature are very important during project-led education; and that project-led education also creates opportunities to learn these skills. But at the UT there are programmes that have chosen to set up a linear line (just like the math line) throughout the curriculum, so it may be more difficult to address these skills just-in-time and integrated in the projects.
An example of learning academic skills is shown in the design of the EE module 1.4. Students are motivated to search for their own literature and resources; these aren't given by the

teachers. Students still receive advised about the literature, but they have to make the final decision themselves.

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