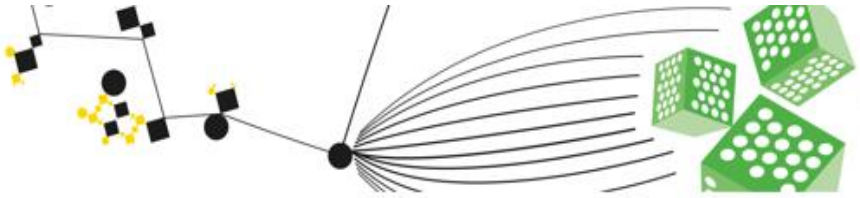

UNIVERSITY OF TWENTE.

The Twente Educational Model

ANALYSING EDUCATIONAL POLICY

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List of Abbreviations

BMS	Faculty of Behavioural, Management and Social Sciences
BSA	Binding Recommendation Instrument
ET	Faculty of Engineering Technology
EWI	Faculty of Electrical Engineering Mathematics and Computer Science
PBL	Problem-based learning
PLE	Project-led Education
SDL	Student-driven Learning
TEM	Twente Educational Model
TNW	Faculty of Science and Technology
UT	University of Twente

Abstract

Study success is a key concept within the area of educational policy. The main aim of this thesis is to examine if the Twente Educational Model (TEM), which was implemented in 2013 at the University of Twente (UT), has improved study success. In this thesis study success is measured by analysing dropout rates. An overview will be given on how educational policy, in particular the introduction of a new educational model, can contribute to improve study success. This is illustrated through a literature review on the elements of the educational model that influence dropout. Important predictors of dropout are conceptualised and identified in this thesis, within the theoretical framework of the educational model. Through the combination of the use of a longitudinal survey dataset and an analysis on dropout-rates, it is showed that TEM did improve study success. The new educational model includes more indicators that positively affect dropout, in comparison with the old educational model. The dropout analysis showed that dropout for first-year bachelor students has decreased after the implementation of TEM. To summarize this thesis illustrates how and through which dimensions the educational model can affect dropout. In addition, more research can be done on the relationship between organisational educational policy and study success, this thesis is just the beginning.

Keywords: *study success, educational model, organisation of higher education, dropout, dropout-rate, learning environment, strategy object, learning methods, educational policy.*

Chapter I: Introduction

§1.1. Introduction

The University of Twente (UT) implemented the Twente Educational Model (TEM) in 2013 to increase study success and make their bachelor programmes more 'fitting' for the student (University of Twente, 2015). The new model implied major changes for the educational structure of the bachelor programmes offered at the UT.

The main aim of this thesis is to investigate if the implementation of TEM has improved study success. This will be done by answering the following research question: 'Does the Twente Educational Model improve study success and which factors contribute to this result?'

In the first part of my thesis, I will analyse how the educational model can affect dropout through a literature review on the educational model. In the second part of my thesis, I will analyse if TEM include more factors that can positively affect dropout. To conclude, in the last part of my thesis I will test if TEM has indeed positively affected dropout by using two different quantitative datasets. This will be followed up by a conclusion in which the final analysis is made and future research recommendations are given.

The University of Twente (2016) believes the new model holds certain benefits in comparison with the old model. One assumption is that within the TEM students are more invited to collaborate with each other and discover their role in a team. They also argue that within the new model students are more challenged and are offered a more attractive and varied curriculum. One of the aims of the university was to eliminate the trend of having students who needed more than 5 years to complete their bachelor programmes. This is also integrated in the model, as students realize in an early stage if they are on the right place (University of Twente, 2016).

From the first cohort of TEM students who started in 2013, the first group graduated in the summer of 2016. During the festive closure of the academic year in 2016, there was a small musical on how the implementation of the TEM affected the students and the staff of the university (University of Twente, 2016). The musical described the challenges and the changes the students and staff of the UT faced in the transition to the new educational model. It included several covers of famous pop and rock songs, with lyrics that could be applied to the journey of the three years with TEM.

The musical started with describing how a couple of years ago, strategic thinkers and the executive board of the UT created a ‘beautiful’ plan and initiative, on the song ‘you are so beautiful’ from the legendary Joe Cocker. The actual plan was encouraged by the so called ‘performance agreements’ set up by Dutch government. In 2012 the Dutch state secretary of Education, Culture and Science (ECS) made these agreements with all Dutch universities to guarantee an increase in educational quality and study success. Universities were invited to formulate their own ambitions and targets in those four-year agreements. Based on the level of the ambitions, their feasibility and their alignment with societal priorities, the government decided, on the advice of an independent review committee to provide more or less financial resources to the individual universities (Rijksoverheid, 2016).

The UT also participated in these agreements by writing a detailed report on the ‘performance agreements’, in which the UT explained how it would improve study quality and study success by setting long term goals (University of Twente, 2012). The report also included the development of introducing a new educational model at the UT, which could improve study quality. This report was assessed and accepted as being an adequate long-term strategy by the Dutch state secretary of ECS.

The musical continued, telling the audience that people started to fear the new TEM. UT employees and the educational staff were worried of the possible workload of the new model. This was illustrated by the music of Dolly Parton with the song ‘Nine to Five’. The students also had some doubts about the workload of the new model, this was illustrated by the protesting lyrics ‘we don’t need no “new” education’ on the song ‘Another Brick in the Wall’ from the timeless band Pink Floyd. The new model introduced a new educational structure for the bachelor programmes, where new ‘modules’ replaced the old quartiles. The modules are centred around one specific (bachelor program related) topic and have a stronger focus on project work, in comparison to the old quartiles in which students had different (sometimes non-related) courses. The key difference is that modules are structured as large units, which must be completed as a whole (University of Twente, 2016).

After highlighting the fears people had of the new educational model, the musical continued with explaining that students became ‘T-shaped’. Which looked weird, but that was intentional. In the new model students became ‘T-shaped professionals’. A T-shaped professional is expected to know all the ins and outs of their field of study and can contribute to its development. The T-shaped professional must also be capable of venturing off the beaten path and applying their knowledge in a broader context, in collaboration with other disciplines and with society (University of Twente, 2016). The new bachelor programmes would be based on the ‘broad’ and ‘deep’ principle. ‘Broad’ implies the ability of the student to apply knowledge across situations whereas ‘deep’ implies the functional/disciplinary skills of the student (University of Twente, 2012).

The musical ended with congratulating the staff and students on completing three years under the new educational model and having the first group of TEM-graduates. This is covered by the classic 'it's been a hard day's night' Beatles song, with a small change of the lyrics to: 'it's been a hard three years'. This illustrates that the implementation of the new model has been a difficult process for both the students and the university staff.

§1.2. Development of the Twente Educational Model

There were two important drivers for renewing the educational structure of the bachelor programmes of the University of Twente (UT). The first drive was the focus on innovating education and increasing the quality of the education under the guidance of the rector magnificus prof. dr. H. Brinksma, who was appointed on the first of January in 2009 (Steens et al., 2015).

The second drive were the so called 'performance agreements' set up by the Dutch government. In 2012, the Dutch state secretary of Education, Culture and Science (ECS) made these agreements with all Dutch universities to guarantee an increase in educational quality and study success. This implied that if universities could increase their quality and study success, they would receive additional budget from the Dutch government (Rijksoverheid, 2016). While at the same time, the Dutch government lowered the budget for higher education due to the economic crisis and the necessity to cut down expenses. One of the aims of TEM was to decrease the UT's costs with 10%. It was also aimed at improving the market position of the UT, by making the university more attractive and capable to compete with other higher educational institutions (Steens et al 2015, p. 39).

The 'UT 2012 performance agreements report' included initiatives to reform the structure of the bachelor programmes offered at the UT. One of the aims of the UT was to offer a bachelor programme that reaches beyond the given discipline of study. This implied that the student can apply the principles they learn within the discipline in different practices. The new bachelor programmes would be based on the 'broad' and 'deep' principle. 'Broad' implies the ability of the student to apply knowledge across situations whereas deep implies the functional/disciplinary skill of the student (University of Twente, 2012).

To increase study success, the UT modularised their bachelor programmes (Steens et al. 2015, p. 39). Within a module, the students receive integrated education and the education is centred on a central theme and project. In this way, students are stimulated to study nominally and complete all the courses offered in a quartile, which will reward them with 15 EC (study credits).

Within TEM, all bachelor programmes consist of integrated modules, were one module also covers one quartile (half a semester). In each quartile (old model) and module (TEM), a student can earn 15 European Credits (EC). In the old model, the academic year was divided in four quartiles in which students would normally follow three courses of 5 EC each. The quartiles under the old educational model consisted of three different courses which did relate to the bachelor programme but not necessarily to each other. The modules do focus on one central theme and have all sorts of subject and learning activities directed to this theme.

The assessment has also changed with TEM. Modules have a form of integrated assessment, which implies that there can be strongly integrated modules with only one grade: the grade achieved for an integrated final test during which all content is assessed at once. This is possible because students receive regular feedback throughout he module without being graded (University of Twente, 2016).

With the implementation of TEM the UT also adopted the binding recommendation instrument (BSA). This implies that during the first academic year at least 45 EC must be completed to continue the study programme. When less than 45 EC are completed, the study programme can still issue a positive recommendation if there is sufficient confidence that you have chosen the right study programme (University of Twente, 2016). Within TEM students can ‘repair’ modules which allows them to still complete the module (and earn 15 EC) whereas under the old educational model students were only able to take re-examinations.

All 19 bachelor programmes offered at the UT are affected by implementing this form of modular education. The bachelor programmes of the UT are:

- Advanced Technology
- Applied Mathematics
- Applied Physics
- Biomedical Technology
- Business & IT
- Chemical Engineering
- Civil Engineering
- Communication Science
- Creative Technology
- Electrical Engineering
- European Public Administration
- Health Sciences
- Industrial Design
- Industrial Engineering and Management
- International Business Administration
- Mechanical Engineering
- Psychology
- Technical Computer Science
- Technical Medicine

The bachelor programmes are divided clustered into four different faculties (University of Twente, 2016):

- Faculty of Behavioural, Management and Social Sciences (BMS)
- Faculty of Engineering Technology (ET)
- Faculty of Electrical Engineering, Mathematics and Computer Science (EWI)
- Faculty of Science and Technology (TNW)

In addition, there is also the faculty of geo-information science and earth observation. However, this faculty is not affected by TEM as the faculty includes only a master's degree. An overview of the development of the TEM is given in figure 1.

Development of TEM-overview	
▪ Scope:	All 19 bachelor programmes of the University of Twente
▪ Aims:	Increase study success, reduce the costs with 10%, improve educational quality, increase attractivity and the ability to compete with other universities
▪ Key elements:	*High Tech* and *Human Touch*, the introduction of the student as researcher, designer and organiser; and a more active approach. Shift from a curriculum with courses to a curriculum with modules
▪ Reform strategy:	From a top-down to a bottom-up approach, shift the focus from teaching to learning
▪ Key actors:	The Rector Magnificus of the University of Twente is at the head of the direction of the educational changes, in each faculty a *primus inter pares* has been appointed to lead the educational changes
▪ Implementation strategies:	Implementation through a certain framework of consultation and discussion, carousels to share '*good practices',* training programs and special designed evaluations and monitoring.

Figure 1. The development of TEM (Steens et al. 2015, p. 39).

§1.3. Research Question

The main aim of my thesis is to explore if the recently implemented Twente Educational Model (TEM) has improved study success. Study success can be measured through observing the dropout, completion rate and time to the degree (Vossensteyn et al. 2014, p. 27). However, in my thesis study success is primarily measured by observing the number of dropouts. A decrease in dropout indicates an increase in study success. In the data and analysis chapter, I will analyse if there is a difference in dropout of first-year bachelor students before and after the implementation of TEM. The dropout-analysis will be done at the institutional (UT) and faculty-level. In addition, I will use a survey dataset to test if factors that can affect study success are more present in TEM in comparison to the old educational model. The survey data is also analysed at the institutional and faculty level.

In other words, I will investigate if the new educational model has increased study success. Therefore, the main research question of my master thesis will be:

'Does the Twente Educational Model improve study success and which factors contribute to this result?'.

To come to an adequate conclusion to my research question, I have created the following sub-questions.

1. What factors influence study success?
2. Which elements of TEM can improve study success?
3. Are these elements more included in TEM in comparison with the old educational model?
4. Is there a significant decrease in dropout after the implementation of TEM?

Chapter II: Theoretical Framework

§2.1. Study success

In this paragraph, I will summarize my literature review on the factors that influence study success. As mentioned in the previous paragraph, in this thesis I will primarily focus on dropout rather than on study completion or the time to the degree. The factors that can influence study success can be found at the individual, institutional and national level. To begin, I will discuss which policies can affect study success to illustrate in which policy area the educational model can be placed. After this, I will outline what factors influence dropout and the dropout decision.

§2.1.1. Policies aimed at improving study success

In general, there are three type of policy instruments that are aimed at improving study success. These are: the organisation of higher education, funding and financial incentives; and information and support for students. These policies can be implemented both at the national or institutional level, as illustrated in figure 2 (Hood & Margetts, 2007), (Vossensteyn et al. 2014, p. 27).

- **Funding and financial incentives:** Financial policy instruments often include incentives to stimulate desired behaviour of students and institutions, or to prevent undesired behaviour. National funding policies and incentives can directly target the students. However, they can also stimulate the institutions to formulate and implement their own policies that improve study success (Vossensteyn et al. 2014, p. 26). Funding instruments can help to provide financial support to students with a lack of economic capital, which enables them to spend more time on their studies rather than on other work they are forced to do to comply with the study costs. At the other hand tuition fees, can be used to make students more sensitive about the costs of (delaying) and can encourage them to choose more carefully and to study efficiently. Public funding to higher education institutions often includes incentives to make institutions pay more attention to study success (e.g. the Dutch performance agreements).
- **Organisation of higher education:** Organisation of higher education refers to structures and procedures related to the organisation of teaching and learning. Organisational policies at the national level are often related to regulate access to higher education, pathways to higher education and within higher education. It also focusses on the quality and accreditation of teaching and learning. In this policy area, institutions can develop their own teaching and learning policies to improve study success. In my thesis, I will primarily focus on this policy area through analysing the educational model. Other incentives on this policy area can be aimed at selection, offering more diverse programme levels, offering a greater variety to students in terms of flexibility to

switch or to academically integrate, or to manage the expectations of students and labour market needs (Vossensteyn et al. 2014, p. 26).

- **Information and support policies:** Information and support for students refers to policies that include information for students and any kind of support for students that is beyond financial assistance and not related to the organisation of learning and teaching. Information addresses prospective students, students switching between programmes or students transferring from a bachelor to a master programme. In addition, it also includes the guidance to future job opportunities. This policy area can help the student to form realistic expectations about study opportunities, programmes and enables the students to make good decisions. Information and support policies include national information services, such as student choice portals, league tables or institutional matching instruments, capability- and interest tests. A better match between students and their study programmes often results in a successful growth in competencies and leads to more study success (Vossensteyn et al. 2014, p. 27).

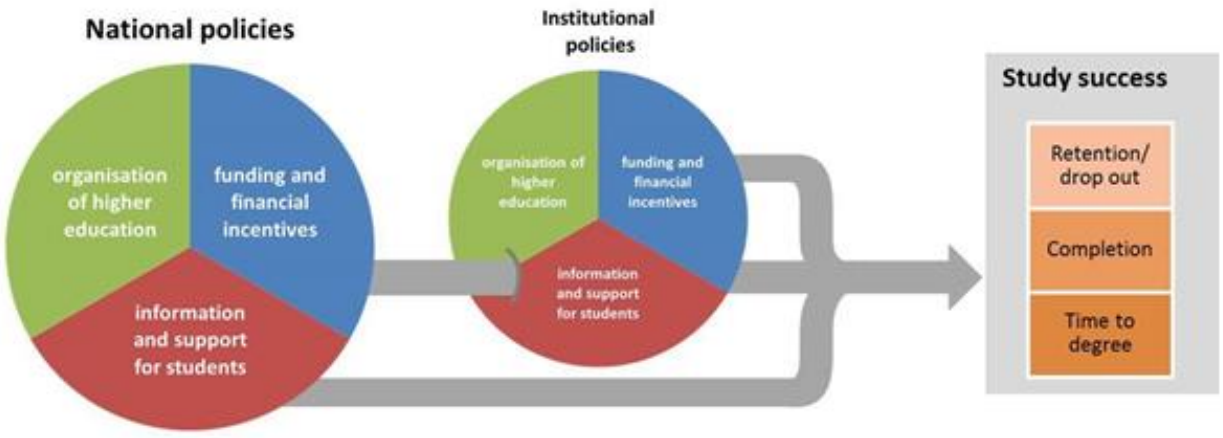

Figure 2. Relationships between policies and study success orientations (Hood & Margetts, 2007), (Vossensteyn et al. 2014, p.27).

In figure 2, study success is displayed as the time to degree, completion and dropout. As mentioned earlier, in this thesis, study success is primarily measured through the observation of the dropout-rates of students. The reason for this is that TEM was implemented in 2013, it is therefore difficult to compare the time to degree and completion differences under TEM and the previous educational model. Instead of comparing different cohorts, I have chosen to measure the differences in the level of dropout before and after TEM for first-year students to assess if study success has improved.

To conclude, in this thesis the primary focus lies on the policy area of ‘organisation of higher education’. The recently implemented TEM is an institutional incentive on the policy area of ‘organisation of higher education’ and its effects can be measured through analysing differences in dropout rates.

§2.1.2. The dropout-decision

As discussed in the previous paragraphs, in this thesis we analyse TEM's impact on study success through the observation of dropout. Students may have various reasons to drop out of their study programmes, in Tinto's (1975, p. 94) original 'longitudinal model of dropout', he states that:

"the process of dropout from college can be viewed as a longitudinal process of interactions between the individual and the academic and social systems of the college during which a person's experiences in those systems continually modify his goal and institutional commitments in ways which lead to persistence and/or to varying forms of dropout."

In his model, he describes that students enter institutions of higher education with a different set of individual attributes (sex, race, ability), pre-college experiences, family backgrounds (socio-economic status) each of which has direct and indirect impact upon study performance in college. These characteristics and individual attributes also influence the development of the educational expectations and commitments the individual brings with him into the study environment (Tinto, 1975). This is displayed in figure 3.

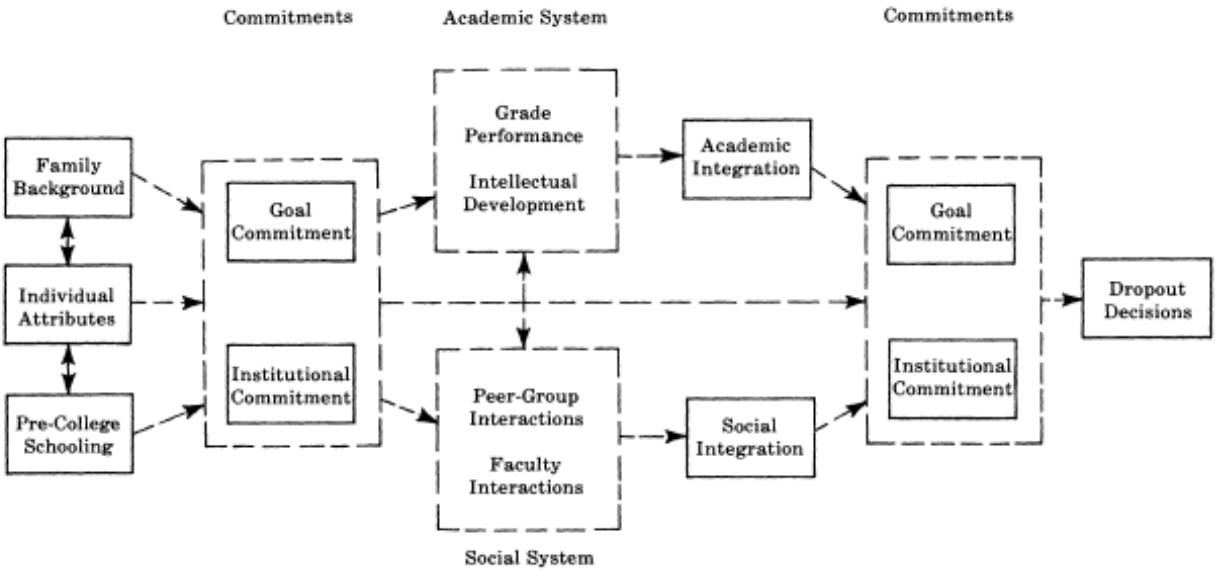

Figure 3. Tinto's Longitudinal Model for Dropout (Tinto, 1975, p. 95).

The family background, the individual attributes and the pre-college experiences can influence a student's goal and institutional commitment which can affect the social and academic system as displayed in Tinto's model. The academic and social system influence the individual's social and academic integration. The higher the level of integration, the greater the student's commitment will be to complete their study programme. In the final analysis, it is the interplay between the individual's commitment to the goal of completion and his commitment to the institution that determines whether the student decides to drop out from college (Tinto, 1975).

Also, the individual attributes and pre-schooling of the students plays an important role in determining study success. The preparedness of the student for higher education and their competence are major determinants for study success. In addition, competences, e.g. diligence, motivation and capacity to concentrate can also influence the study outcome (Vossensteyn et al. 2014).

The academic system in Tinto's model refers to the 'individual' academic integration, that can be measured in terms of both the grade performance and the intellectual development during the college years. The grades of a student represent the reward of the person's participation in the college, this participation rewards the student with resources for future educational and career mobility. Intellectual development is another form of reward a student receives through college participation, which is an integral part of the person's personal and academic development. Whereas intellectual development can be seen as the individual's evaluation of the academic system, grade performance reflects, the notion that the student is also being evaluated and judged by that system. Grade performance reflects the person's ability and of the institution's preferences for particular styles of academic behaviour (Tinto, 1975, p. 104).

The social system deals with the social integration of the student, which involves notions of both levels of integration of degrees of congruency between the individual and his social environment. Social integration primarily occurs through informal peer group associations, semi-formal extracurricular activities and the interaction with faculty and administrative personnel within the college. It follows that successful encounters in these areas result in varying degrees of social communication, friendship support, faculty support and collective affiliation, each of which can be viewed as an important social reward that increases the likelihood that the person will remain in college (Tinto, 1975, p 107). The TEM aims to influence social integration, by increasing faculty and peer-group interactions (University of Twente, 2016). The educational model affects the academic and social integration of the students, this will be explained in the next paragraph.

§2.2. The educational model

In this paragraph, I will outline the conceptual framework of an educational model, such as TEM, to illustrate how a higher education institution can organise teaching and learning to improve study success. The educational model is a complex organisational system, designed by the institution to achieve certain learning and teaching goals and to improve study success (Vossensteyn et al. 2014, p. 26).

The educational model consists of three dimensions: the knowledge object, the strategy object and the learning environment (Poortman & Sloep, 2006, p. 6). The knowledge objects are the sources of information and knowledge within an educational model. These objects define the type of information, the availability of the information and how this information is processed. The knowledge object has not changed significantly after the implementation of TEM, since TEM focusses primarily on the re-organisation of higher education.

Strategy objects are characterised by a didactical structure, they consist out of the assignment, the learning goals and the assessment (Poortman & Sloep, 2006). The learning environment involves the interaction between students, and the interaction between students and teachers (Meeuwisse et al. 2010). The strategy object and the learning environment are aimed at certain teaching and learning goals that can enhance study success, therefore these dimensions will be further analysed in the following two paragraphs. The three dimensions of the educational model are illustrated in figure 4.

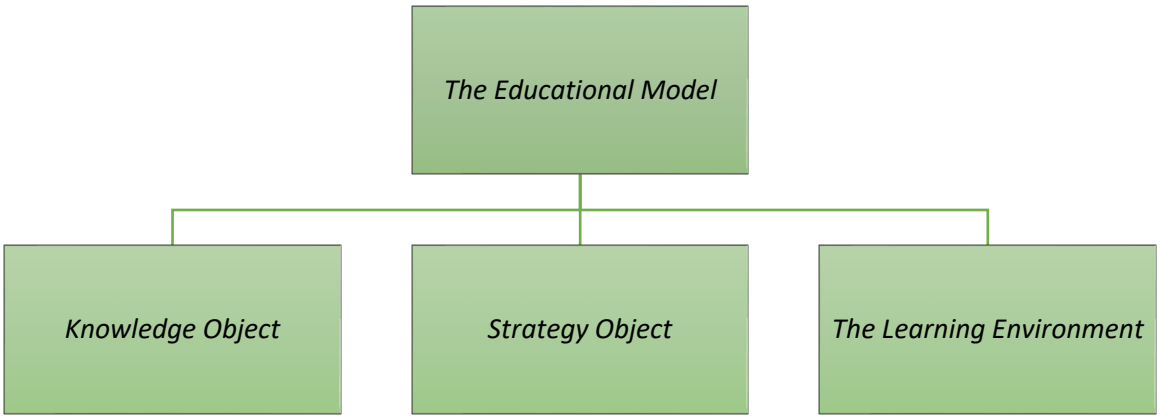

Figure 4. The Educational Model

§2.2.1. The Strategy Object

As mentioned earlier, the strategy object consists out of the assignment, the learning goals and the assessment. There are different processes of learning that can be integrated within the assignment. In this paragraph, I will discuss which processes of learning and which learning goals can be integrated in the strategy object. After the implementation of TEM, the strategy object of the educational model had an increased focus on project-based learning. The use of project-based learning within TEM will be further outlined in this paragraph.

The learning processes are mainly activated through the assignments students receive within their study programme. First off, there is the 'reproductive' mode of learning, were tasks and methods are connected based on routine connections rather than based on analysis and interference. This is a sufficient and necessary level of learning, but can only be used for handling routine problems that occur frequently (Hüttel & Gnaur, 2015, p. 19).

A mode of learning that goes beyond 'reproductive' learning is 'developmental learning'. In this case, the learner must engage in a more active process of knowledge-based problem solving, by experimentation, which implies to invent and test solutions to the given problem based on knowledge about the task and about possible alternative solutions. The highest form of developmental learning is 'creative learning' where the learner uses his or her own authority to find solutions and to experiment (Hüttel & Gnaur, 2015, p.20).

A commonly used form of creative learning is problem-based learning (PBL). In PBL students use 'triggers' from the problem case or scenario to define their ow learning objectives (Silver, 2004). With PBL, students do independent, self-directed study before returning to the group to discuss and refine their acquired knowledge. PBL Is not primarily focussed on solving problems per se, but rather it uses appropriate problems to increase knowledge and understanding (Wood, 2003).

The advantage of PBL is that is facilitates communication skills, teamwork, problem solving and independent responsibility for learning, sharing information and respecting others (Wood, 2003) (Silver, 2004).

Another learning process which can be included in the strategy object is student-driven learning. Student-driven learning implies learners' involvement in self-assessment of their objective and of their subjectively felt needs and in planning, monitoring, and evaluation of their learning. It also implies the development of autonomy as learners become more capable of directing their own learning, but not necessarily that the learning is entirely self-directed. In most cases of learner-directed learning, the learner choses the learning process in close consultation with the teacher (Benson, 2012, p. 33).

A form of learning that combines developmental and reproductive learning, is ‘project-based’ learning. Project-based learning allows students to learn by doing and by applying ideas. Students are stimulated to engage in real-world activities that are similar to the activities that adult professionals engage in. Project-based learning is a form of situated learning and it is based on the constructivist finding that students gain a deeper understanding of material when they actively construct their understanding by working with and using ideas (Blumenfeld & Krajcik, 2006). According to Blumenfeld & Krajcik (2006, p. 318) project-based learning combines:

1. Active construction
2. Situated learning
3. Social interactions
4. Cognitive tools

Active construction implies that a deep understanding occurs when a learner actively constructs meaning based on their experiences and interaction in the world, and that only superficial learning occurs when learners passively take in information. With situated learning, the learning takes place in an authentic, real-world context.

Project-based learning also involves social interaction, the best learning results from a kind of social interaction: when teachers, students and community members work together in a situated activity to construct shared understanding.

Lastly, with project-based learning the cognitive tools allow the students to amplify and expand what they can learn. Various forms of computer software can be considered cognitive tools because they allow learners to carry out tasks not possible without the software’s assistance and support. An example of a cognitive tool, might be a software programme that allows the student to visualize complex datasets (Blumenfeld & Krajcik, 2006).

There can be ‘open’ and ‘closed’ (structured) projects within project-based learning. A structured or closed project has a ‘right’ answer, which implies that teachers know what the final product should look like. Whereas when the project is ‘open’, the teacher nor the tutors know how the final product should look like. In this case, the final solutions of the student groups can (and preferably will) differ from one group to another (Alink & Berg, 2013).

With the implementation of TEM, the UT integrated a form of project-based learning: project-led education (PLE). As mentioned before, the aim of TEM is to learn the students to become T-shaped professionals (University of Twente, 2016). This implies that 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. Rather than having a form of ‘surface’ learning, the ‘project-led education’ implies having a form of project-based learning in which the students can apply their knowledge in different (real-life) contexts (Alink & Berg, 2013).

TEM tries to integrate the different parts of the module by using PLE, so the students will see the module as ‘one’ unit and can relate the different subjects of the module to each other. Within TEM a project is an activity in which a group of students collaborate to develop and apply new knowledge, skills and attitudes by solving a problem within a certain set of boundaries and conditions (Alink & Berg, 2013, p. 2).

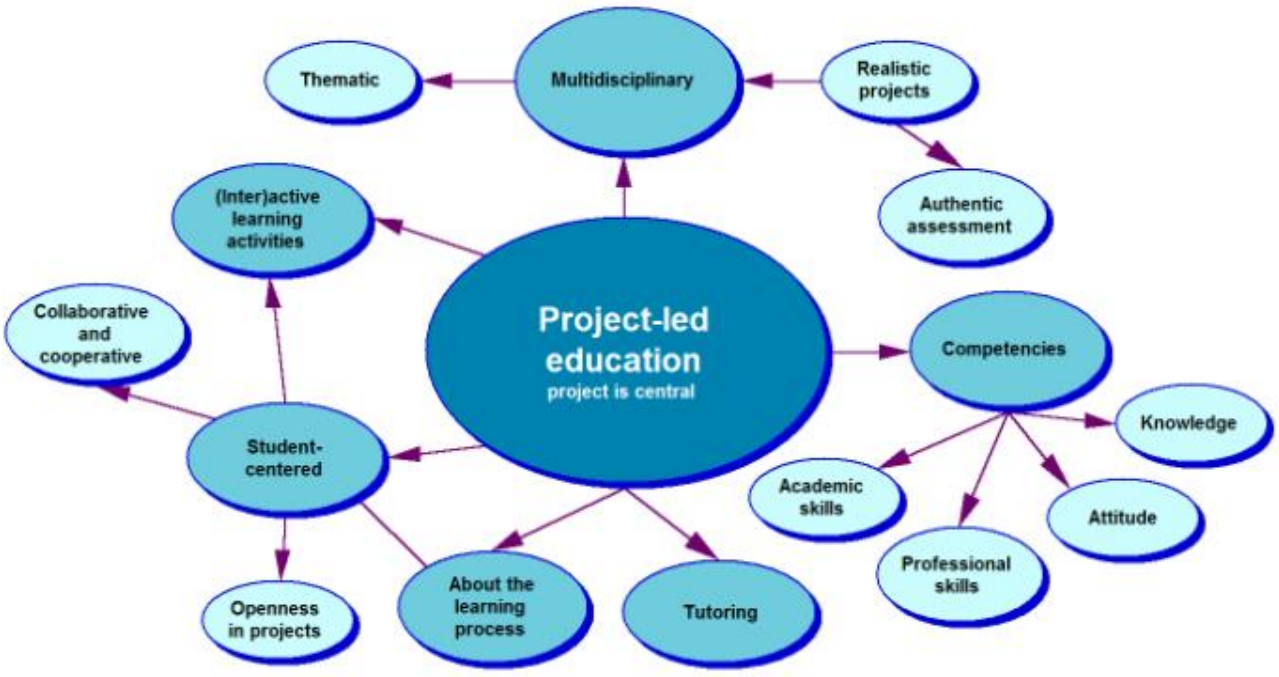

Figure 5. Project-led Education (Alink & Berg, 2013, p. 2).

As we can see in figure 5, the project is central and leading in in the modules. By using PLE, active learning is stimulated. This does not mean that there are no lectures in the module, the designers of the project must decide which form of teaching fits the learning goals best (Alink & Berg, 2013).

During the design of a module, the designers must decide which form of teaching fits the learning goals best. They can choose to use ‘open’ or ‘closed’ projects (Alink & Berg, 2013). The key difference is that the old educational mainly had ‘closed’ projects which were predetermined through the specific course objectives, while at the other hand the TEM allows for more ‘openness’ in projects.

Another important aspect of PLE is that it increases student-centeredness in projects. The teacher can give students influence in different areas of the project. These areas are (Alink & Berg, p. 5):

1. Content
2. Scheduling
3. Choice on learning activities
4. Type and frequency of assessment

PLE is also used as an instrument to let students work collaboratively as well as cooperatively. One of the reasons to work in groups is the collaboration between the students; they can be motivated and learn from each other. A problem may arise without inter-disciplinary learning. The students could still divide the work and still work in parallel and independently from each other. Therefore, TEM includes multidisciplinary projects; in which students from different disciplines work together on a common problem. 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 (Alink & Berg, 2013).

TEM aims at having a multidisciplinary approach, therefore it is recommended that students from different bachelor programmes work together in a project on multiple occasions. Sometimes a mixture of social and technical studies is needed to give adequate solutions to real-world problem scenarios (University of Twente, 2015).

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. Therefore, projects within PLE are ‘realistic’ projects, where students work on realistic tasks. By using realistic projects, there is opportunity for deeper evaluation of student learning. Students at the UT are expected to become T-shaped professionals, which implies that they can connect their knowledge with other disciplines and the society. Authentic assessment can play an important role for students to reach this deeper kind of knowledge (Alink & Berg, 2013, p. 10).

Within PLE there is space for inter-active learning activities. These activities are student-centred, and in active learning activities students actively gain knowledge instead of passively receiving knowledge by e.g. reading a book or listening to a teacher. An overview of examples of (student-centred) active learning-activities is given in figure 6.

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	

Figure 6. Student-centred learning activities (Alink & Berg, 2013, p. 11).

Teachers in higher education often offer too much content during lectures, due to their desire to cover all the content. Therefore, the UT's goal is to shift the focus from teaching to learning. PLE allows students to decide on their own preferred learning process within the project (Alink & Berg, 2013).

PLE also implies that each module is covered by one central theme. In figure 7, the rows represent the traditional design of a curriculum, where the blue frames show which parts are connected by a common theme. If cells from different modules have a similar colour, it implies that the same course line is addressed; but the theme is different. By combining different parts by a theme, it's easier to create a project that includes different disciplines, which opens the possibilities for PLE (Alink & Berg, 2013, p. 14).

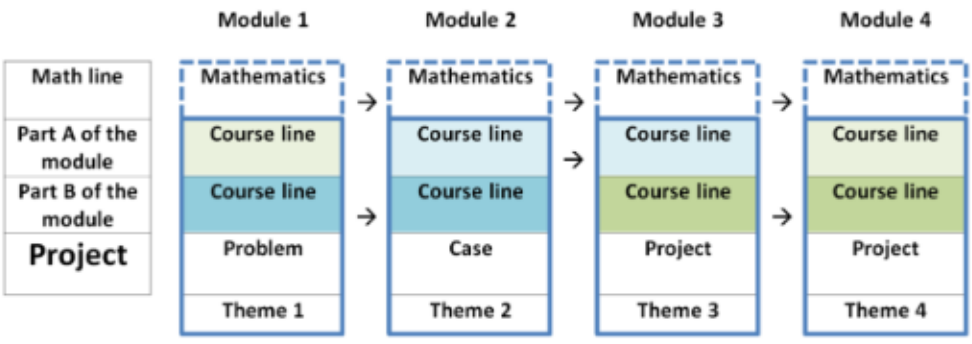

Figure 7. The design of the module within TEM (Alink & Berg, 2013, p. 14).

Within TEM more focus was given to learner-centred teaching at the UT (Steens et al. 2015). Learner-centred teaching implies that the teacher is aware of the diversity among the learners, has knowledge of their students and has the ability to adapt teaching to their students' collective and individual needs (Benson, 2012). Accordingly, teachers who teach with a student-centred approach are more likely to achieve deep-learning. This implies that teachers have to 'let go' and trust their students in their eagerness to learn and do the 'right thing'. Through the integration of learner-centred teaching students have more responsibility and will need to develop a professional attitude towards learning (Alink & Berg, 2013).

A project can be used as an instrument for students to work collaboratively as well as cooperatively. When students collaborate they, all strive for the same goal. When students cooperate, they don't have to strive for the same goal but it is important that students work together. Cooperative learning is based on the idea that students can work more effectively when they cooperate instead of competing (Alink & Berg, 2013).

In both approaches students work together, but the key difference is that students who work collaboratively are assessed together; which theoretically means that all students receive the same grade. Whereas in cooperative work the students work together in the same project but also have individual responsibilities that they work on outside the project (Alink & Berg, 2013).

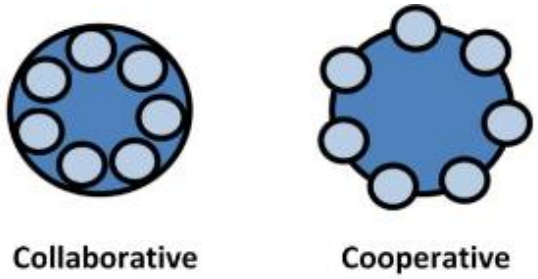

Figure 8. The difference between collaborative and cooperative (Alink & Berg, p. 8.)

Using collaboration, students can share knowledge with one another. A shared vision is very important as it enables to stimulate your imagination on what is possible in the not-too-distant future for the betterment of learning and human performance through the effective instructional use of learning objects (Hodgins, 2002). Together the students are better able to gain sufficient knowledge of all aspects of the project or assignment on which they collaborate. It follows the example of Michelangelo (an Italian sculptor, painter, architect and poet), who worked together with a group of sixteen individuals to paint the ceiling of the Sistine Chapel. Michelangelo wanted to achieve a perfect result, but he soon realised that it is not the work of a single individual, however gifted, but the creation of a project team working on a shared vision that could achieve greatness (Hodgins, 2002, p. 3).

Another important aspect of learning together is that students can give each other feedback on how to improve their knowledge and skills. Feedback can also reflect on the process of group work, sometimes there are group members who for example are not working as efficiently as others.

The learning goals of the strategy object are aimed at achieving an effective form of 'learning'. In Merrill's (2002, p. 45) model, he argues that the most effective learning methods are those that are problem-centred and involve the student in four distinct phases of learning:

1. Activation of prior knowledge
2. Demonstration of skills
3. Application of skills
4. Integration of these skills in real-life activities

In addition, Merrill (2007, p. 35) adds five principles that promote learning:

1. Learning is promoted when learners are engaged in solving real-world problems.
2. Learning is promoted when existing knowledge is activated as a foundation for new knowledge.
3. Learning is promoted when new knowledge is demonstrated to the learner.
4. Learning is promoted when new knowledge is applied by the learner.
5. Learning is promoted when new knowledge is integrated in the learner's world.

The five principles that promote learning can be paired together with the four phases of learning, this is displayed in figure 9. The model of David Merrill (2007) summarizes what the main learning goals are, within the strategy object of the educational model.

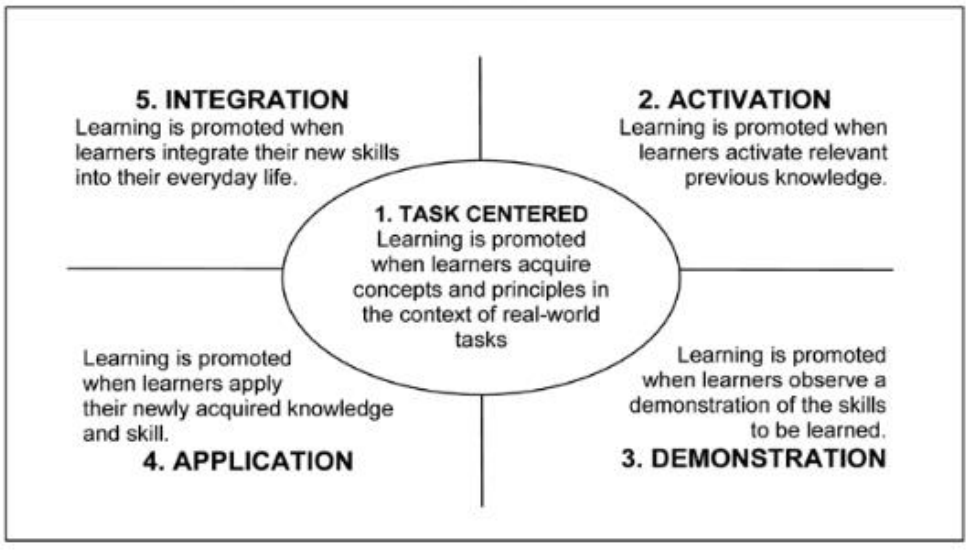

Figure 9. Principles for Effective Instruction (Merril, 2007, p. 35).

§2.2.2. The learning environment

As we have seen in the previous paragraph, the strategy object is mainly focussed on the learning process. The learning environment however, consists of the teaching and the social environment within the study programme. The learning environment is shaped by the interaction of the student with fellow students and the interaction of the students with the teacher, this is displayed in figure 10.

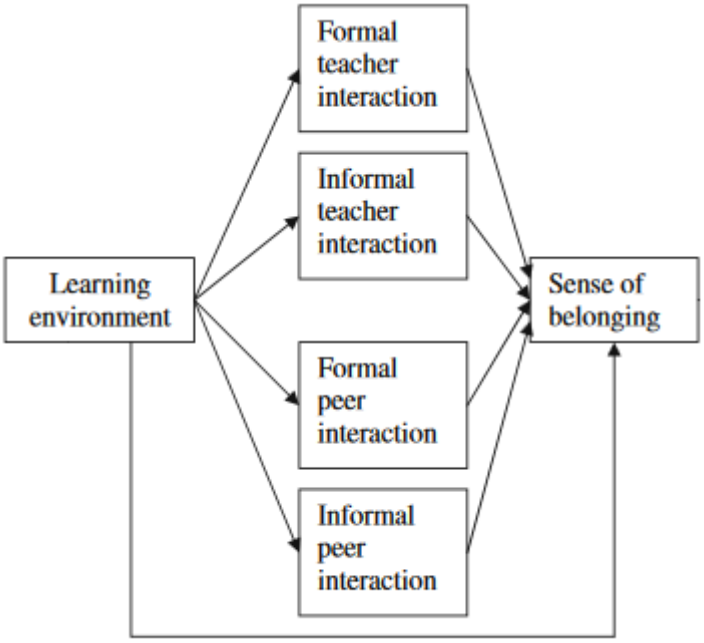

Figure 10. The learning Environment (Meeuwisse et al. 2010, p. 534).

Meeuwisse et al. (2010) model for the learning environment is closely related to the social system dimension in Tinto's (1975) model for dropout, but adds the concept of 'sense of belonging'. As we can see in figure 6, the interactions between students and teachers form a certain 'sense of belonging'. In Tinto's original theory (1975) social integration refers to informal peer group associations, semi-formal extracurricular activities and interaction with faculty and administrative personnel within the college.

Meeuwisse et al. (2010) add a variation to Tinto's model, and argue that the quality of interactions among peers and between peers and teachers are the key aspects that together shape the 'sense of belonging'. In an earlier qualitative study conducted in the Netherlands (Severiens et al. 2006), 138 students were interviewed and asked about social and academic experiences in different periods during their study. The results showed that the quality of interaction between students and between the students and teachers were important indicators that influenced the sense of belonging (Meeuwisse et al. 2010).

The learning environment can also directly affect the sense of belonging. This is not an effect of the interaction between peers or between peers and teachers but an effect of the group composition within the study programme. When students are surrounded by a presence of students of a similar age, class, gender or ethnicity they are more likely to feel like they belong (Meeuwisse et al. 2010).

The educational model can also include learner-centred teaching, which is also a part of the learning environment. Learner-centred teaching implies that the teacher is aware of the diversity among the learners, has knowledge of their students and can adapt teaching to their students' collective and individual needs (Benson, 2012). The main justification for learner-centred teaching in comparison towards teacher-centred teaching, is pedagogical and is based on the argument that it leads to more effective learning for several reasons (Benson, 2012, p. 32):

- It is sensitive to individual needs and preferences
- It encourages construction of knowledge and meaning
- It draws on and integrates language learning with students' life experiences
- It generates more student participation and target-study output
- It encourages authentic communication
- It breaks down barriers between in-class and out-of-class learning
- It opens spaces for discussion of motivations, learning preferences and styles
- It encourages students to take more personal responsibility for their learning
- It challenges the view that learning is equivalent to being taught

To conclude, the strategy object and learning environment can be used to achieve certain learning and teaching goals that can improve study success. This is illustrated in figure 11.

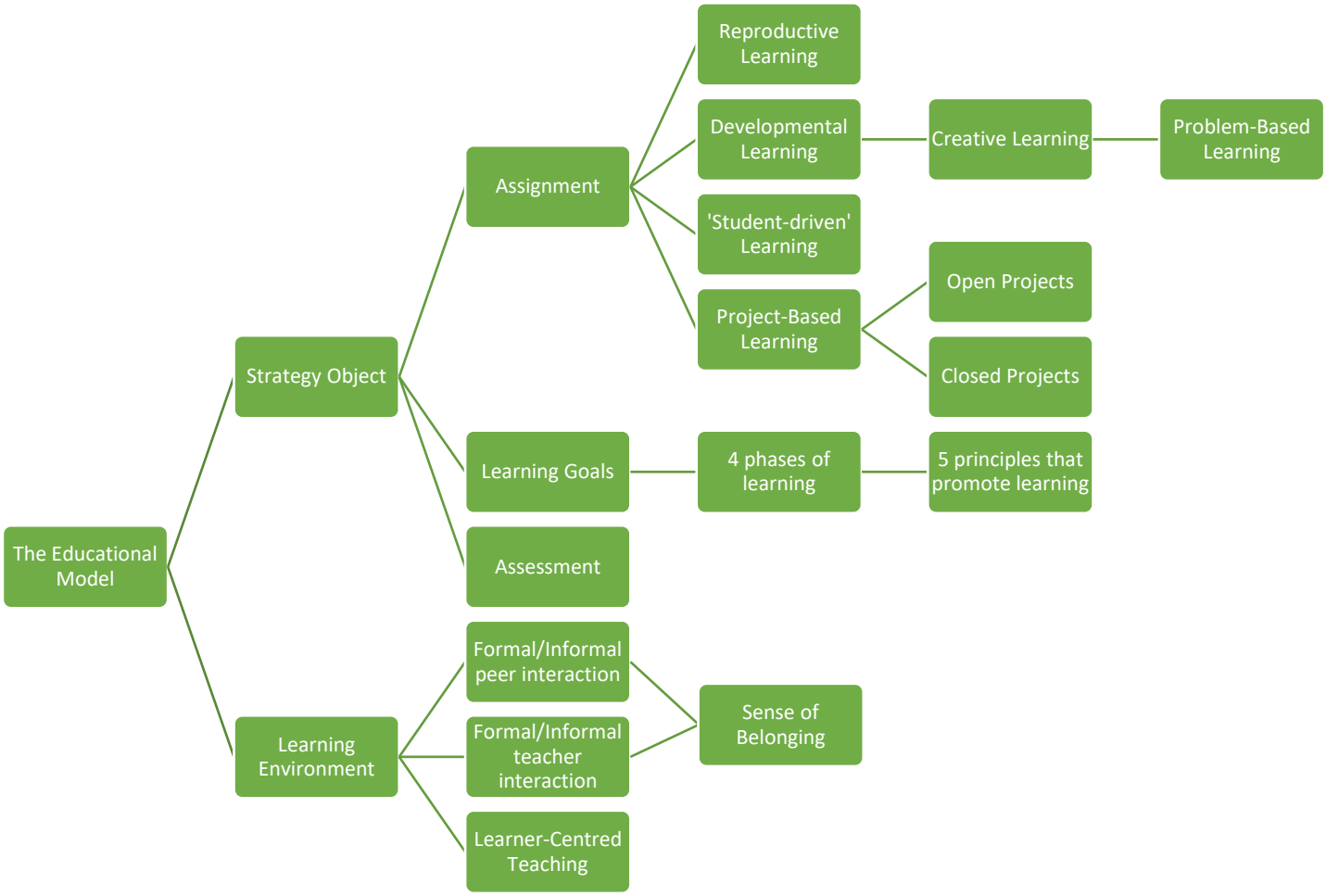

Figure 11. The conceptual framework of the educational model.

§2.3. The influence of the educational model on dropout

As stated earlier, in this thesis we rely on Tinto's (1975, p. 95) longitudinal model for dropout that explains dropout on the individual level. The educational model however has no influence on the family background, individual attributes and pre-college schooling. The educational model affects academic integration and social integration through the academic and social systems. In order to illustrate how the educational model can influence the dropout decision, I have created a new model which is illustrated in figure 12.

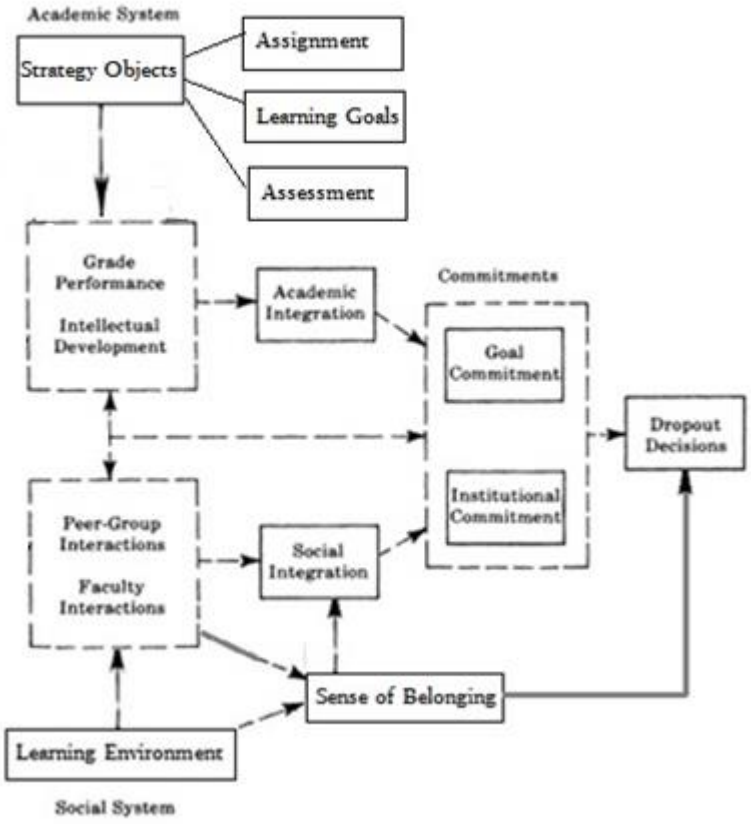

Figure 12. Tinto's model for dropout modified by the author.

As our new model illustrates, the educational model affects the dropout decision through the learning environment and the strategy objects. The strategy object mainly affects the grade performance and the intellectual development of the students. Whereas the learning environment directly affects peer-group interactions, faculty interactions and the sense of belonging. It follows that the strategy object can stimulate academic integration while at the other hand the learning environment can influence social integration.

In theory, the educational model has an influence on the dropout decision through the influence of the strategy object and influence of the learning environment. These are the two 'main' dimensions of the educational model that can influence dropout. I have summarised the two dimensions in figure 13.

Dimensions	*Conceptualization*
1. Strategy Object	
▪ Assignment	▪ Can be divided in reproductive, developmental, student-driven and project-based learning
▪ Learning goals	▪ The four phases of learning and the five principles for effective instruction
▪ Assessment	▪ Deals with how the students are 'assessed' within the study programme
2. Learning Environment	
▪ Informal/formal contact of students with other students	▪ Contact between students through informal peer group associations, semi-formal extracurricular activities
▪ Informal/formal contact of students with teachers	▪ Contact between the teacher and the student through interaction with the faculty and administrative personnel within the college
▪ Sense of Belonging	▪ The quality of interactions among peers and between peers and teachers together shape the 'sense of belonging'
▪ Learner-Centred Teaching	▪ the teacher is aware of the diversity among the learners, has knowledge of their students and can adapt teaching to their students' collective and individual needs

Figure 13. Dimensions of the educational model that can affect study success.

Within the strategy object, the assignment, the assessment and learning goals can affect the grade performance and intellectual development of the student. Having different learning processes, clear and effective learning goals or regular feedback and assessments can increase the grade performance and intellectual development of the students.

Next to the strategy object, the learning environment is also an important dimension of the educational model that can affect the dropout decision. The learning environment does not affect the academic system but the social system in Tinto's (1975) model for dropout. It is not the learning environment itself but the 'sense of belonging' that influences the study success (Meeuwisse et al. 2010). Quite often students experience a lack of socialization or alienation during their studies. Feeling alienated or having difficulty in making friends can have a negative impact on the students' performance (Meeuwisse et al. 2010).

This effect can intensify for ethnic minority students, which can even lead to reasons to withdrawal from the study programme. Ethnic minority students appear to feel less at home in their educational programmes in comparison to the domestic students, and this feeling of alienation might result in negative study outcomes or in extreme cases leads to withdrawal of the student. Whereas students who are surrounded by a presence of students of a similar age, class, gender or ethnicity are more likely to feel like they belong and therefore are more likely to succeed in their studies (Meeuwisse et al. 2010). This implies that the 'sense of belonging' is an important variable that influences study success.

As we can see in figure 12, the 'academic system' consists of the assessment, the assignment and the learning goals. Together these variables can influence the intellectual development and the grade performance of the student. Following Tinto's (1975) model, this affects the academic integration, the level of goal/institutional commitment and eventually the dropout decision.

If we look at the social system, we see a different type of relationship. The learning environment itself affects the interaction of the student but can also affect the sense of belonging. The sense of belonging is influenced by the learning environment, the interaction with peers and teachers. The sense of belonging affects social integration, but can also directly affect the dropout decision. This is the case when students don't feel like they belong, due to the fact of being an ethnic minority or unable to socially integrate. If students are surrounded by students who have the same individual characteristics, social integration is stimulated, which can also positively affect the dropout decision.

In addition, I will analyse the influence of the educational model at the UT level and the faculty level. The reason for this is that the organisational changes that come with the implementation of TEM might affect social and technical faculties differently. By analysing the organisational changes on the faculty level, I will be able to see if the educational model affects the faculties differently.

To summarize, figure 12 illustrates how an educational model might influence the study outcome. In the next part of this thesis I will outline how the TEM has changed the educational model of the UT. This allows me to compare the old model with the TEM, to evaluate if the TEM might have improved study success.

Chapter III: Research Methodology

§3.1. Introduction

In this chapter, I will operationalise how the elements of the educational model affect the dropout decision. As we have seen in the previous chapter, the educational model mainly affects dropout through the influence of two dimensions: the strategy object and the learning environment. In this chapter, I will shed light on how the elements of the educational model can influence the dropout decision, starting with the strategy object. This operationalisation allows me to explore how TEM changed the strategy object and the learning environment, and how this has affected dropout.

§3.2. The Strategy Object

As mentioned earlier, the strategy object consists of the assignment, the learning goals and the assessment. The assignment and learning goals can influence the dropout decision, this is illustrated in figure 14. No clear links between the assessment of students and dropout can be found in the existing literature on the organisation of higher education.

Figure 14 shows how the learning methods, learning goals and assessment methods can be measured and implemented within the educational model. This allows us to investigate which of these elements are more present in TEM in comparison with the old educational model. It also illustrates how these elements can be implemented in the new educational model. A positive sign indicates a positive effect on dropout: a decrease of dropouts; whereas a negative sign indicates that dropout increases.

Strategy object	Variable	Value	Implementation	Effect on dropout
Assignment	How is learning organised?	Reproductive learning	Repetition of routine learning activities	+
		Developmental learning	Through forms of creative learning, such as problem-based learning	+
		Student-driven learning	The student determines the learning method	+
		Project-based learning	Through project-work and active learning	+
Learning goals	What are the learning goals?	Task centered	Students acquire concepts and principles in context of real-life tasks	+
		Activation of knowledge	Students activate previous relevant knowledge	+
		Demonstration of knowledge	Students receive a demonstration of the skills to be learned	+
		Application of knowledge	Students apply their newly learned skills	+
		Integration of knowledge	Students integrate their new knowledge in everyday life	+
Assessment	How are students assessed?	Integrated assessment	Assessing the work of the student all at once	
		Periodic assessment	Frequently testing of students by e.g. small assignments or periodic exams	

Figure 14. How the Strategy Object affects dropout.

§3.3. The Learning Environment

In this paragraph, I will outline how the dimension of the learning environment can affect dropout. As stated earlier, the learning environment consists of informal/formal contact of students with other students, the informal/formal contact of students with teachers and the sense of belonging. Figure 15 illustrate how the elements of the learning environment can measured and implemented within the educational model. Again, a positive sign indicates a decrease in dropouts and a negative sign implies an increase of dropouts.

Learning Environment	**Variable**	**Value**	**Implementation**	**Effect on dropout**
Contact of students with other students	How do students communicate with each other?	Collaboration	Working on project together	+
		Active learning activities	Having open debates, discussions in lectures	+
		Contact in the standard lecture format	Contact between students during lectures	-
Informal/formal contact of students with teachers	How do students and teachers communicate with each other?	Learner-centred teaching	Teacher is aware of the diversity among the learners, has knowledge of their students and can adapt teaching to the students' collective and individual needs	+
		Teacher as 'the lecturer'	Main aim of the teacher is to transfer knowledge	-
		Teacher as 'the tutor'	Teacher steers and guides the project, in project-based learning	+
Sense of belonging	What shapes the sense of belonging?	Contact between students	Informal peer group associations, semi-formal extracurricular activities	+
		Contact between teachers and students	Interaction with faculty and administrative personnel within the college	+

Figure 15. How the Learning Environment affects dropout.

As illustrated in figure 15, contact between students in the ‘standard lecture format’ does not positively affect dropout. This is explained by the fact that within the ‘standard lecture format’ students barely communicate with each other, due to structure of the lecture. Within the ‘standard lecture format’ the main aim of the teacher is to transfer all the knowledge within the given time of the lecture, so there is no room left for students to discuss or collaborate on the course material.

This is a problem that arises when the teacher adopts the role of the lecturer. The lecturer’s main aim is to cover all the course content during lectures instead of having a form of active learning where students directly participate by having debates or discussions in class.

The operationalisations made in this chapter, make it possible to compare the old educational model with TEM. It enables me to analyse if, within TEM, more variables are present that could have had a positive effect on dropout. This theoretical comparison, together with the dropout and survey analysis, enables me to investigate if TEM has improved study success.

§3.4. The organisational changes after TEM

In this paragraph, I will discuss how the organisational changes after the implementation of TEM might have affected dropout. An overview will be given of the most important organisational changes after TEM and how these changes might have influenced dropout. As we have seen in the previous paragraphs, the educational model mainly influences the dropout decision through the strategy object and the learning environment. The strategy object can influence academic integration whereas the learning environment can influence social integration. In our model, social and academic integration are the most important predictors of the dropout decision.

As mentioned earlier, the level of academic and social integration can be influenced by the educational model through the strategy object and the learning environment. To measure if TEM has a positive effect on dropout, the changes are analysed using the literature. A summary of the changes and their predicted effect on dropout is given in figure 16. A positive sign indicates that dropout is positively affected which indicates that the total number of dropouts decreases, where a negative sign indicates that dropout is negatively affected which indicates that the total number of dropouts increases.

The strategy object has undergone some changes after the implementation of TEM. The key changes for the assignment within the educational model are an increase in project-based learning and student-driven learning. Student-driven learning and project based learning can both stimulate academic integration. Student-driven learning can improve the intellectual development and grade performance of the students, as they are able to select their preferred learning methods. Whereas project-based learning involves a higher level of active learning which also stimulates intellectual development and can increase the grade performance. Therefore, both indicators can have a positive effect on dropout.

The learning goals have also changed after the implementation of TEM. Within the new educational model there is an increased focus on the fifth principle of Merrill (2007, p. 35): learning is promoted when new knowledge is integrated in the learner's world. This indicates that effective learning is more promoted after the implementation of TEM. A higher level of effective learning results in better grade performance and intellectual development and therefore positively affects the level of dropout.

The assessment has also changed with the implementation of TEM, with the adoption of the BSA instrument the assessment became stricter. In the short term, this negatively affects dropout. However, the UT uses this instrument to assess if the student has chosen the right study programme. After the first wave of dropouts, there might only be students left who are a perfect fit for the study programme they follow. The BSA instrument therefore might have a positive effect on the level of dropout in the long run.

Next to the strategy object, the learning environment has also changed after the implementation of TEM. Within the old model, the contact between students mainly occurred during the standard lecture format. After the implementation of TEM, students also communicated with each other during team-projects. Through the application of project-led education, the students are engaged in more active-learning activities. This further stimulates contact and social relations between other students. The increase of contact between other students might result in more social integration, which has a positive effect on dropout.

Another key change in the learning environment is the shift from teacher-centred teaching towards learner-centred teaching. This implies that the teacher is more directed towards the needs of the student. In the old educational model, the teacher takes the role of the lecturer, whereas within TEM the teacher can also adopt the role of tutor. Within the project the tutor will have four important tasks (Alink & Berg, 2013, p. 13):

1. Monitoring
2. Critical reflection
3. Expertise
4. Supporting collaboration between students

Within the module students and teachers will discuss the progress and the approach that the students have chosen, to monitor the progress of the project. The student may also contact the tutor if they have any questions of their own, so that the tutor can shed their critical reflection on the project. The tutor also shares their expertise on the content with the student, or refers the students to an expert on the specific content. Another aspect of the tutor's job is to guide the collaboration, so that the group does not depend on one or two strong members of the group (Alink & Berg, 2013). However, the tutor is not an advisor when it comes to personal issues or individual study issues. In this case, he directs the student towards to the study advisor who can also refer to a student psychologist.

The monitoring of students, giving critical reflection and sharing expertise can also lead to more informal/formal contact between teachers and students. In addition, supporting collaboration between students is not only beneficial for the teacher-students' relationship but also for the contact between students. To conclude, the increase in learner-directed teaching and project-based learning (where the teacher also takes the role of the tutor) leads to more social integration, which has a positive effect on the dropout decision.

Through the application of project-led education and the shifted focus towards more learner-centred teaching, the informal/formal contact between students and between students and teachers is further stimulated. Following our model for dropout, this can also increase the sense of belonging, which may directly result in less dropout and an increase in social integration.

Strategy object	*Old Model*	*TEM*	*Change*	*Effect on Dropout*
Assignment	Room for projects, but project is not central	Project is central, team projects in which real-world problems are addressed	Increase in project-based learning	+
	Final assignments, projects or examinations	Integrated projects, through project-led education	Increase in project-based learning	+
	Teacher determines learning process	Student determines learning process	Increase in student-driven learning	+
Learning goals	Focusses on Merrill's first four principles that promote learning	Focusses on all Merrill's principles	Increased focus on integrating knowledge in the learner's world	+
Assessment	Courses are assessed separately	Integrated assessment, with possibility to repair the module	Stricter assessment by the integration of the BSA instrument	-
Learning Environment	*Old Model*	*TEM*	*Change*	*Effect on Dropout*
Informal/formal contact of students with other students	Mostly contact within the standard lecture format	Contact/collaboration through interactive learning activities	Increase in the level of active learning through project-led education	+
Informal/formal contact of students with teachers	Role of teacher: the lecturer. Focusses on teacher-centred teaching.	Role of the teacher: the tutor and the lecturer. The teacher is more directed towards the needs of the student.	An increase in learner-centred teaching.	+
Sense of belonging	Is mainly shaped inside the standard lecture format	Also shaped through collaboration in projects and active learning	Increase in project-based learning, increase learner-centred teaching	+

Figure 16. Changes after TEM and their effect on dropout.

§3.5. Measuring the effect of TEM

As we have seen in the previous paragraph, the implementation of TEM has changed the organisational structure of the educational model. If we look at the organisational structure of the educational model, TEM implied the following changes:

- Increase in project-based learning
- Increase in active learning
- Increase of collaboration of students
- Increase in learner-centred teaching
- Increase in student-driven learning
- Stricter assessment by adopting the BSA instrument

As discussed in the previous paragraph these changes also affect the dropout. The effect of TEM on the dropout decision is visualized in figure 17.

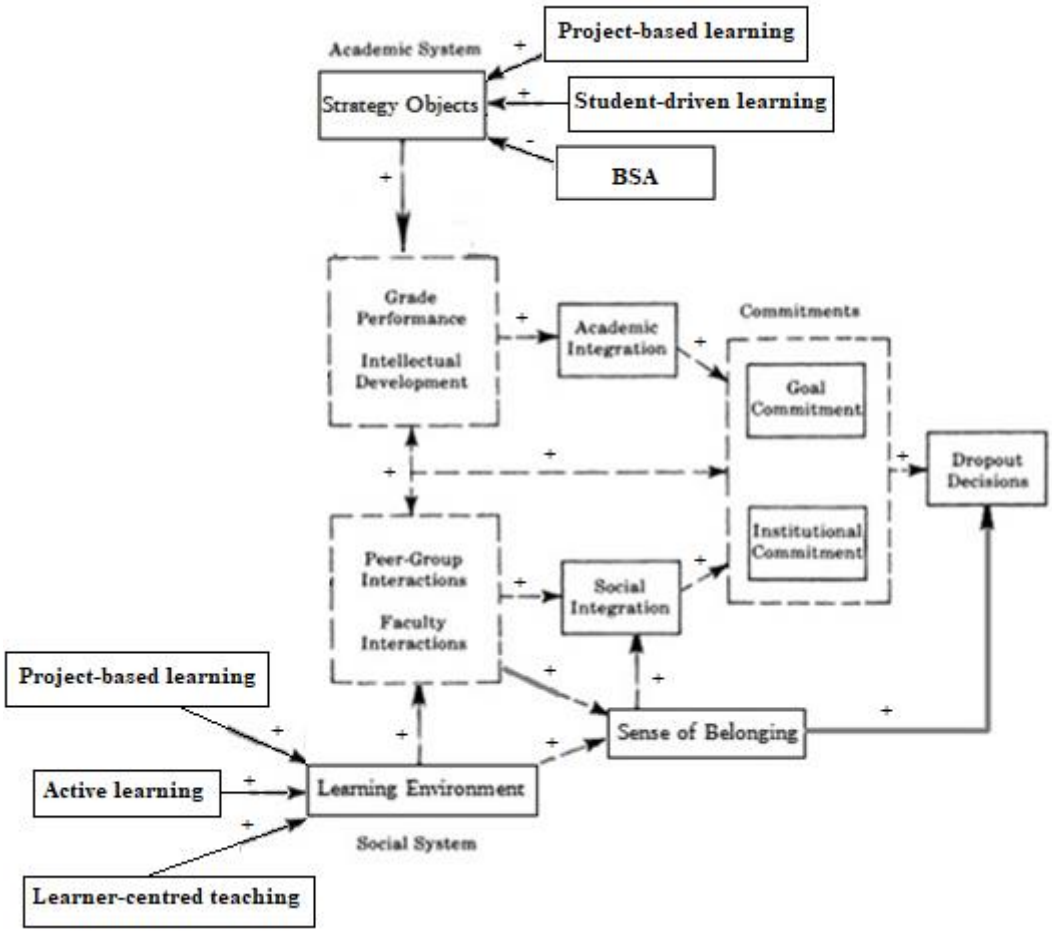

Figure 17. The effect of TEM on the dropout decision.

To measure if TEM has positively affected dropout, we first must analyse if these organisational changes are indeed more included in the new educational model. To test this, I have chosen to use a longitudinal survey data set which includes the experiences of the students with their study programme. By using the survey dataset, I can analyse whether the students also experience these organisational changes. The dataset I will use is provided by the NSE and was collected in the period of 2010-2016, more information on this dataset will follow in the next chapter. Figure 18 summarizes which indicators can be measured by using the NSE dataset.

Dimension	**Variable**	**Measurable?**	**Through indicators**
Strategy Object	Project-based Learning	yes	• Collaboration in projects • level of active learning
	Student-driven Learning	yes	• student-driven learning
	Adoption of the BSA instrument	no	
Learning environment	Project-based Learning	yes	• collaboration • level of active learning
	Learner-centred Teaching	yes	• relationship between student/teacher
	Active Learning	yes	• increase in active learning activities

Figure 18. Measuring the effect of TEM through the indicators.

Following our model of dropout, the increased presence of the above listed indicators should result in a decrease of dropout. To investigate if the dropout has indeed decreased after the implementation of TEM, I will use a longitudinal dataset of dropout rates. This dataset is provided by the UT and allows me to analyse the dropout rates for first-year bachelor students in the period of 2010-2016. This enables me to analyse if the dropout has decreased after the implementation of TEM in 2013. By conducting the research in this order, I will able to provide an answer to the main research question of this thesis.

Chapter V: Data and Analysis

§5.1. Introduction

To measure if the satisfaction with the indicators mentioned in figure 18 has changed with the implementation of TEM, I have chosen to use a longitudinal survey dataset for the period of 2010-2016 provided by the NSE. By using this dataset, I can analyse if TEM indeed includes project-based learning, active learning, student-driven learning and learner centred teaching.

§5.2.1. The NSE dataset

The Dutch NSE ('Nationale Studenten Enquête') is a large-scale national survey analysis in which students give their opinions on their study programmes and their educational institutions. The survey is handed out each year to all students who are enrolled in a study programme at a higher education institution in the Netherlands. Students are not obliged to evaluate their study programmes using the NSE surveys but are encouraged to do so. The NSE survey measures the level of satisfaction of the student on several topics, and uses the answer format of the Likert-scale with scores of 1 (=very unsatisfied) to 5 (=very satisfied). The NSE consists of a questionnaire asking students to rate the following aspects:

- General assessment of the study programme
- Content of the study programme
- Skills acquired
- Preparation for a professional career
- Teachers and lecturers
- Information provided
- Study facilities
- Testing and assessment
- Programme schedules
- Study load
- Academic guidance/counselling

In addition, students are asked to rate the city in which they are studying and the availability and affordability of student housing (NSE, 2016). The NSE dataset includes the results from surveys which were given to students who follow or followed a bachelor programme at a Dutch higher education institution in the period of 2010-2016. The surveys are filled in anonymously but students do have to fill in at which institution they study and which study programme they follow. This allowed me to filter the dataset into students who followed a bachelor programme at the University of Twente in the period of 2010-2016. The total number of students who filled in the questionnaire is (N=) 15054. The sample consists of students who are (or were) enrolled in one of the 19 different bachelor programmes offered at the University of Twente.

The total number of bachelor-students who are enrolled in a bachelor programme at the UT changes each year, as new students enrol and others might drop out. The number of NSE respondents are the students who were enrolled in a bachelor programme at the UT in the period of 2010-2016 and filled in the survey. The NSE response rate for each year is displayed in table 1.

Table 1. Total number of bachelor students and NSE-respondents.

Year	*Total number of bachelor students*	*Number of NSE respondents*	*NSE Response Rate %*
2010	5929	2193	36.98%
2011	6064	2305	38.01%
2012	5741	1483	25.83%
2013	5650	2305	40.79%
2014	5627	1834	32.59%
2015	5260	2139	40.67%
2016	5900	2795	47.37%

Table 1 also shows us that a decent number of students who follow (or followed) a bachelor programme at the UT have taken the time to participate in the NSE survey, especially compared to the national response rate. In 2013 for example, the average national response rate per institution was only 25% while for the UT this was 40.79%. The same accounts for the year 2015 where the national response rate was 30% and the UT had a response rate of 40.67%. This implies that our dataset is a good representation of the bachelor students who followed a bachelor programme at the UT in the period of 2010-2016. The only question is whether dropouts respond more/less often than successful students. If more dropouts would fill in the questionnaires we expect the satisfaction scores to be lower. For this research, I have divided the respondents by the four different faculties offered at the UT. The distribution of respondents among the faculties is displayed in table two.

Table 2. Number of valid respondents by faculty each year.

	Faculty				
	BMS	ET	EWI	TNW	Total
2010	830	516	273	574	2193
2011	939	478	299	589	2305
2012	588	286	209	400	1483
2013	956	448	321	580	2305
2014	703	356	277	498	1834
2015	716	449	370	604	2139
2016	952	558	465	820	2795

As mentioned earlier, the NSE surveys contain questions in which the student can rate their level of satisfaction with scores of 1 to 5. It is interesting to analyse if these scores differ before and after the implementation of TEM. As TEM was implemented on the second of September in 2013, in this analysis scores of 2010-2013 will be compared with scores of 2014-2016. The NSE survey questionnaires are handed out to students in January each year, and they have until March of that year to fill in the questionnaire (NSE, 2016). This means that the results of 2013 are filled in by students who studied under the old model, from 2014 onwards the NSE results include the opinions of students who study under the new TEM.

§5.2.2. Measurement of the indicators

In this paragraph, I will outline how the indicators as illustrated in figure 18 can be measured by using the NSE survey dataset. The operationalisation of the indicators is summarised in figure 19.

Indicators	Item	NSE-question
Collaboration	Satisfaction with collaboration	B.3.e
Teacher-student relationship	Satisfaction with guidance/counselling provided by the teacher	B.6.e
	Satisfaction with teacher-involvement	B.6.d
	Satisfaction with teacher-feedback	B.6.f
Active learning	Satisfaction with level of active learning	B.5.b
Student-driven learning	Satisfaction with level of authority a student has in selecting the learning method	B.2.h

Figure 19. Operationalisation of the indicators that influence the dropout decision.

As figure 19 illustrates the indicators that can be measured using the NSE dataset are: collaboration, the teacher-student relationship, active learning and student driven learning. All items could be rated with scores of 1 (=very unsatisfied) to 5 (+very satisfied. To investigate if these are more present in TEM, we will compare the satisfaction levels for the different indicators before (2010-2013) and after (2014-2016) of TEM.

For each indicator, the scores on the faculty level for the period of 2010-2016 will be compared. To begin I will summarize the mean scores for each faculty for each indicator, after which I will investigate if there is a significant difference in satisfaction scores for the indicators before and after the implementation of TEM.

To test if the TEM has influenced the level of satisfaction for the different indicators, I have formulated a null hypothesis and an alternative hypothesis:

H(0): there is no difference in the level of satisfaction before and after the implementation of TEM.

H(A): there is a difference in the level of satisfaction before and after the implementation of TEM.

If the results are not statistical significant, we can say that there is no difference in the level of satisfaction of a certain indicator before and after the implementation of TEM. However, if the results are statistical significant, we can say that there is a difference in satisfaction before and after the implementation of TEM.

In addition, it is also interesting to investigate if there is a difference in mean-scores between faculties to see if the indicators are more or less present within a faculty. To test if there is a significant difference, I have formulated the following hypothesis:

H(0): there is no difference in mean-scores for satisfaction between the different faculties.

H(A): there is a difference in the mean-scores for satisfaction between the different faculties.

Again, if the results are statistically significant, it indicates that there is a significant difference in the mean-scores for satisfaction between the four different faculties. I have chosen to compare the faculties for the year of 2016, to test if there are any differences to be found.

§5.3. Collaboration

Under the ‘acquired skills’ section the NSE included a question that asks the student if they are satisfied with the degree of collaboration/cooperation with other students within the study programme. As mentioned earlier, all items can be rated with scores of 1 (=very unsatisfied) to 5 (+very satisfied). An overview of the mean-score for each faculty and the mean-score at UT level is given in table 3. The horizontal line in table 3 illustrates the period before and after the implementation of TEM.

Table 3. Satisfaction mean-scores for collaboration by faculty by year.

Year	***BMS***	***ET***	***EWI***	***TNW***	***UT (total)***
2010	3.94	4.44	4.02	4.03	4.09
2011	3.88	4.43	3.91	4.05	4.04
2012	3.92	4.49	4.02	4.07	4.08
2013	3.87	4.47	4.07	4.12	4.08
2014	3.97	4.41	3.98	4.12	4.10
2015	4.07	4.42	4.19	4.16	4.19
2016	4.26	4.45	4.24	4.31	4.31

Table 3 illustrates that the mean-score for collaboration increases at the UT level from 4.09 to 4.31. The faculties of BMS and TNW follow this trend, as their mean-scores for collaboration increases. For ET and EWI this positive trend of an increasing mean-score is less visible. As mentioned earlier, we compare the mean-scores for the period of 2010-2013 and 2014-2016. The mean score at the UT level for 2010-2013 is 4.03 and increases in the period of 2014-2016 to 4.21. By using an independent samples test, we see that the difference is significant (sig. level < 0.000), which indicates that there is a difference in the level of satisfaction with collaboration before and after the implementation of TEM at the UT level. The differences in mean-scores for collaboration by faculty before and after the implementation of TEM can be found in table 16.

The next step is to analyse if there are significant differences in satisfaction between faculties. This can be done by comparing the mean-scores for the year of 2016 for the different faculties by using a One-way ANOVA test. I have chosen to use 2016 for this sample, as faculties are more likely to differ from each other if I would compare the data for the period of 2010-2016.

Table 4. Differences in mean scores on collaboration between faculties in 2016.

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
BMS	ET	-,188*	,040	,000	-,29	-,08
	EWI	,022	,048	,966	-,10	,14
	TNW	-,042	,036	,648	-,13	,05
ET	BMS	,188*	,040	,000	,08	,29
	EWI	,210*	,050	,000	,08	,34
	TNW	,146*	,039	,001	,05	,25
EWI	BMS	-,022	,048	,966	-,14	,10
	ET	-,210*	,050	,000	-,34	-,08
	TNW	-,064	,046	,508	-,18	,06
TNW	BMS	,042	,036	,648	-,05	,13
	ET	-,146*	,039	,001	-,25	-,05
	EWI	,064	,046	,508	-,06	,18

*. The mean difference is significant at the 0.05 level.

Table 4 shows that some faculties significantly differ from each other. The faculties BMS and ET, EWI and ET, and lastly TNW and ET significantly differ from each other in mean-scores of satisfactions for collaboration. The results are not unexpected as table 3 already showed us that BMS and TNW follow the same trend, whereas ET and EWI the mean-scores do not clearly follow the same trend.

To conclude, we have seen that the average mean-score of satisfaction with collaboration increased after the implementation of TEM in 2013. The difference between the mean-score of satisfaction with collaboration before and after the implementation of TEM is significant. The One-Way ANOVA test outcome illustrates that significant differences can be found in the mean-scores for satisfaction with collaboration between the four faculties.

§5.4. Satisfaction with guidance/counselling

The NSE survey also contained a question that asked if students were satisfied with the guidance/counselling provided by the teacher, which is one of the indicators of the quality of the teacher-student relationship. An overview of the mean-score for each faculty and the mean-score at UT level is given in table 5.

Table 5. Satisfaction mean-scores for guidance/counselling by faculty each year.

Year	*BMS*	*ET*	*EWI*	*TNW*	*UT (total)*
2010	3.56	3.78	3.86	3.79	3.71
2011	3.51	3.84	3.84	3.79	3.69
2012	3.53	4.00	3.94	3.84	3.76
2013	3.38	3.83	3.80	3.85	3.64
2014	3.48	3.81	3.74	3.80	3.67
2015	3.56	3.84	3.75	3.71	3.69
2016	3.59	3.84	3.87	3.78	3.74

Table 5 shows that the mean-score of satisfaction with guidance/counselling for BMS is higher than the previous years. For ET, EWI and TNW this is not the case. For the faculty of TNW the highest score can be found in 2013. For ET and EWI the highest scores for guidance/counselling are found in 2012. If we look at the mean-scores at the UT-level, we see that it is the highest in 2012, but decreases again in 2013. In 2014-2016 the mean-score seems to increase again to 3.74.

As mentioned earlier we compare the mean-scores for the period of 2010-2013 and 2014-2016. The average mean score at the UT level for 2010-2013 is 3.69 and increases in the period of 2014-2016 to 3.71. By using an independent samples test, we see that the difference is not significant (sig. level 0.411), which indicates that there is no significant difference in the level of satisfaction with guidance/counselling provided by the teacher before and after the implementation of TEM at the UT-level. The differences in mean-scores for guidance/counselling by faculty before and after the implementation of TEM can be found in table 16.

The next step is to analyse if there are significant differences in the mean-scores for satisfaction with guidance/counselling between faculties in 2016. The results are displayed in table 6.

Table 6. Differences in mean scores for guidance/counselling between faculties in 2016.

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
BMS	ET	-,243*	,046	,000	-,36	-,13
	EWI	-,277*	,050	,000	-,40	-,15
	TNW	-,189*	,041	,000	-,29	-,08
ET	BMS	,243*	,046	,000	,13	,36
	EWI	-,033	,053	,922	-,17	,10
	TNW	,055	,045	,612	-,06	,17
EWI	BMS	,277*	,050	,000	,15	,40
	ET	,033	,053	,922	-,10	,17
	TNW	,088	,049	,273	-,04	,21
TNW	BMS	,189*	,041	,000	,08	,29
	ET	-,055	,045	,612	-,17	,06
	EWI	-,088	,049	,273	-,21	,04

*. The mean difference is significant at the 0.05 level.

Table 6 shows us that the faculty of BMS differs significantly from all other faculties. This is also visible in table 5, which shows us that BMS holds the lowest mean-scores each year for satisfaction with guidance/counselling provided by the teacher. Where guidance/counselling seems to work for the technical faculties of ET, EWI and TNW it seems to be less effective for the faculty of BMS. However, the mean score for guidance/counselling for BMS does appear to be increasing after 2013. For BMS the mean score is 3.49 in the period of 2010-2013 and this increases to 3.55 in the period of 2014-2016. The difference is also significant, with a sig. level of 0.01.

To conclude, we have seen that the mean-score for satisfaction with guidance/counselling provided by the teacher is higher after the implementation of TEM. However, in contrast with the indicator of collaboration this does not seem to be a significant difference. Another thing that stands out is the significant difference between BMS and the other faculties. Although the BMS mean-scores seem to be lower in comparison with the other faculties, the mean-score for BMS increases significantly after the implementation of TEM.

§5.5. Satisfaction with teacher-involvement

Another important indicator of the quality of the relationship between the teacher and student is the level of satisfaction with the involvement of the teacher. The NSE survey also included a question that asked if students were satisfied with the involvement of the teacher with the student. Similar to the previous mentioned indicators, the students could rate their level of satisfaction with scores of 1 to 5. The mean-scores for each faculty in the period of 2010-2016 are summarised in table 7.

Table 7. Satisfaction mean-scores for teacher-involvement by faculty each year.

Year	*BMS*	*ET*	*EWI*	*TNW*	*UT (total)*
2010	3.53	3.90	3.95	3.89	3.76
2011	3.52	3.96	4.05	3.83	3.76
2012	3.52	4.09	4.06	3.92	3.81
2013	3.33	3.91	3.94	3.96	3.69
2014	3.47	3.91	3.90	3.88	3.73
2015	3.56	3.98	3.96	3.81	3.79
2016	3.66	4.00	4.08	3.93	3.87

Table 7 shows us that the mean-scores for satisfaction with teacher-involvement are the highest in 2016, when looking at the scores at the UT-level. For the faculties ET and TNW, the mean scores are not the highest in 2016. For ET, the mean-score is the highest in 2012, where for TNW the score is the highest in 2013. Another thing that stands out is that for the faculty BMS, the average mean scores seem to be lower in comparison with the other faculties.

As mentioned before we compare the mean-scores for the period of 2010-2013 and 2014-2016. The average mean score at the UT level for the period of 2010-2013 is 3.75 and the mean score increases to 3.81 in the period of 2014-2016. By using an independent samples test, we see that the difference is significant (sig. level < 0.000), which indicates that there is a significant difference in the level of satisfaction with teacher-involvement before and after the implementation of TEM at the UT-level. The differences in mean-scores for teacher-involvement by faculty before and after the implementation of TEM can be found in table 16.

The next step is to analyse if there are significant differences in the mean-scores for satisfaction with teacher-involvement between faculties in 2016. The results are displayed in table 8.

Table 8. Differences in mean-scores for teacher-involvement between faculties in 2016.

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
BMS	ET	-,335*	,048	,000	-,46	-,21
	EWI	-,412*	,052	,000	-,55	-,28
	TNW	-,261*	,043	,000	-,37	-,15
ET	BMS	,335*	,048	,000	,21	,46
	EWI	-,076	,055	,514	-,22	,07
	TNW	,075	,047	,386	-,05	,20
EWI	BMS	,412*	,052	,000	,28	,55
	ET	,076	,055	,514	-,07	,22
	TNW	,151*	,051	,017	,02	,28
TNW	BMS	,261*	,043	,000	,15	,37
	ET	-,075	,047	,386	-,20	,05
	EWI	-,151*	,051	,017	-,28	-,02

*. The mean difference is significant at the 0.05 level.

Table 8 illustrates that the faculty of BMS differs significantly on the mean-scores for teacher-involvement in comparison with the other faculties. This was also the case with the indicator of satisfaction with guidance/counselling provided by the teacher. In addition, the faculties TNW and EWI also seem to significantly differ from each other. Again, the trend of an increasing mean-score is best visible for the faculty of BMS.

To conclude we can say that the satisfaction with teacher-involvement has significantly increased after the implementation of TEM. This is clearly for the faculty of BMS, but also significant for all faculties.

§5.6. Satisfaction with quality of teacher-feedback

Another indicator that influences the student-teacher relationship is the quality of the teacher feedback. The NSE also included a question in which students could assess their satisfaction with the quality of teach-feedback, with scores of 1 to 5. The average mean-scores for the different faculties are summarised in table 9.

Table 9. Satisfaction mean-scores for teacher-feedback by faculty each year.

Year	*BMS*	*ET*	*EWI*	*TNW*	*UT (total)*
2010	3.41	3.52	3.75	3.57	3.52
2011	3.36	3.64	3.65	3.54	3.50
2012	3.43	3.65	3.73	3.60	3.56
2013	3.29	3.59	3.66	3.58	3.47
2014	3.28	3.50	3.53	3.61	3.45
2015	3.38	3.61	3.50	3.51	3.49
2016	3.42	3.57	3.64	3.57	3.53

In contrast to the satisfaction scores of the previous analysed indicators, the satisfaction mean score for teacher-feedback doesn't appear to clearly increase or decrease, if look at the mean-scores at the UT-level. For all faculties, there does not seem to be a clear trend in the mean-scores for satisfaction with teacher-feedback when analysing the scores on the long run.

The average mean score at the UT-level for the period of 2010-2013 is 3.51 and the mean score decreases to 3.49 in the period of 2014-2016. By using an independent samples test, we see that the difference is not significant (sig. level 0.373), which indicates that there is no significant difference in the level of satisfaction with teacher-feedback before and after the implementation of TEM. The differences in mean-scores for teacher-feedback by faculty before and after the implementation of TEM can be found in table 16.

The next step is to analyse if there are significant differences in the mean-scores for satisfaction with teacher-feedback between faculties in 2016. The results are displayed in table 10.

Table 10. Differences in mean-scores for teacher-feedback between faculties in 2016.

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
BMS	ET	-,144*	,048	,015	-,27	-,02
	EWI	-,218*	,053	,000	-,35	-,08
	TNW	-,153*	,043	,002	-,26	-,04
ET	BMS	,144*	,048	,015	,02	,27
	EWI	-,074	,057	,558	-,22	,07
	TNW	-,009	,047	,997	-,13	,11
EWI	BMS	,218*	,053	,000	,08	,35
	ET	,074	,057	,558	-,07	,22
	TNW	,065	,052	,600	-,07	,20
TNW	BMS	,153*	,043	,002	,04	,26
	ET	,009	,047	,997	-,11	,13
	EWI	-,065	,052	,600	-,20	,07

*. The mean difference is significant at the 0.05 level.

Although there is no significant difference in the mean-score before and after the implementation of TEM at the UT-level, the faculties do differ significantly from each other. All faculties significantly differ from the faculty of BMS. This was the same for the indicator of satisfaction with the guidance/counselling provided by the teacher. To conclude for the satisfaction with teacher-feedback there are no significant changes before and after the implementation of TEM. This could imply that the teacher-feedback indicator is not (extremely) affected by the implementation of the new educational model.

§5.7. Satisfaction with active learning

The degree of active learning is also an important indicator that might affect study success, as it can stimulate intellectual development and can improve the relationship between students, and the relationship between students and teachers. The NSE also included a question, asking the student if they are satisfied with the level of active learning in their study programme (NSE, 2016). For this question, the students could rate their level of satisfaction with scores of 1 to 5. An overview for the mean scores for satisfaction with active learning is given in table 11.

Table 11. Satisfaction mean-scores for active learning by faculty each year.

Year	*BMS*	*ET*	*EWI*	*TNW*	*UT (total)*
2010	3.01	3.68	3.56	3.49	3.36
2011	2.91	3.66	3.53	3.48	3.29
2012	2.96	3.82	3.67	3.50	3.37
2013	2.79	3.74	3.67	3.49	3.27
2014	2.91	3.71	3.76	3.49	3.34
2015	3.08	3.59	3.80	3.50	3.42
2016	3.21	3.64	3.89	3.60	3.51

When comparing the mean-scores at the UT-level, we see that the mean-score slightly increases over time to 3.51 in 2016. For the faculties BMS, TNW and EWI the mean score is the highest in 2016. For ET, the mean score is the highest in 2012, after which it decreases to 3.59 in 2015. In 2016, the mean-score for the faculty ET increases again to 3.64.

In line with other indicators, such as collaboration and teacher involvement the mean scores seem to increase over time, if look at the mean-scores at the UT-level. For the faculty ET, this is less visible.

The average mean score at the UT-level for the period of 2010-2013 is 3.32 and the mean-score increases to 3.44 in the period of 2014-2016. By using an independent samples test, we see that the difference is significant, with a sig. level < 0.000. This implies that there is a significant difference in the level of satisfaction with teacher-feedback before and after the implementation of TEM at the UT level. The differences in mean-scores for active learning by faculty before and after the implementation of TEM can be found in table 16.

The next step is to analyse if there are significant differences in satisfaction with the level of active learning between faculties for the year of 2016. The results are displayed in table 12.

Table 12. Differences in mean-scores for active learning between faculties in 2016.

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
BMS	ET	-,439*	,058	,000	-,59	-,29
	EWI	-,686*	,061	,000	-,84	-,53
	TNW	-,356*	,052	,000	-,49	-,22
ET	BMS	,439*	,058	,000	,29	,59
	EWI	-,247*	,064	,001	-,41	-,08
	TNW	,083	,056	,448	-,06	,23
EWI	BMS	,686*	,061	,000	,53	,84
	ET	,247*	,064	,001	,08	,41
	TNW	,330*	,059	,000	,18	,48
TNW	BMS	,356*	,052	,000	,22	,49
	ET	-,083	,056	,448	-,23	,06
	EWI	-,330*	,059	,000	-,48	-,18

*. The mean difference is significant at the 0.05 level.

For the indicator satisfaction with the level of active learning all faculties except for ET and TNW, differ significantly from each other. This implies that it is difficult to argue if the effect of the implementation of the new model has affect all faculties on the same manner, regarding the indicator of active learning.

What we can conclude is that there is a significant increase in the satisfaction with active learning for all faculties. However, almost all faculties seem to differ from each other for this indicator so it is hard to argue if a change in the level of active learning had the same impact on the different faculties.

§5.8. Satisfaction with authority

The level of authority a student has in choosing their preferred learning method, can also be measured by using the NSE dataset. In the section of 'content of the study programme' there is a question that asks if the student is satisfied with the ability they have in determining the learning method and the learning content. The mean-scores for satisfaction with authority of choosing learning methods are summarised in table 13.

Table 13. Satisfaction mean-scores for authority by faculty each year.

Year	*BMS*	*ET*	*EWI*	*TNW*	*UT (total)*
2010	3.04	3.18	3.40	3.27	3.17
2011	3.03	3.30	3.42	3.23	3.19
2012	3.02	3.33	3.37	3.15	3.16
2013	2.96	3.10	3.33	3.11	3.08
2014	2.80	2.90	3.22	3.04	2.95
2015	2.93	3.01	3.29	3.06	3.04
2016	2.88	2.86	3.32	3.11	3.01

Table 13 shows that after the implementation of TEM (2014-2016) the mean-scores seem to be lower, when comparing the mean-scores at the UT-level. For almost all faculties the mean-scores for satisfaction are lower in comparison to the scores before the implementation of TEM. This in contrast to the mean-scores of the previous mentioned indicators, which all increased after the implementation of the new educational model.

The average mean score at the UT-level for the period of 2010-2013 is 3.15 and the score decreases to 3.01 in the period of 2014-2016. By using an independent samples test, we see that the difference is significant, with a sig. level < 0.000. This implies that there is a significant difference in the level of satisfaction with authority in choosing the learning methods before and after the implementation of TEM at the UT-level. This is not what we expected, as one of the aims of TEM is to integrate student-driven learning, which increases the student's authority in selecting the learning process (University of Twente, 2016). The differences in mean-scores for authority by faculty before and after the implementation of TEM can be found in table 16.

It is also interesting to investigate if the faculties differ from each other in the mean-scores for satisfaction with authority in the year 2016. The result is displayed in table 14.

Table 14. Differences in mean-scores for authority by faculties in 2016.

(I) Faculty	(J) Faculty	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
BMS	ET	,020	,054	,983	-,12	,16
	EWI	-,438*	,061	,000	-,60	-,28
	TNW	-,228*	,049	,000	-,35	-,10
ET	BMS	-,020	,054	,983	-,16	,12
	EWI	-,458*	,066	,000	-,63	-,29
	TNW	-,248*	,055	,000	-,39	-,11
EWI	BMS	,438*	,061	,000	,28	,60
	ET	,458*	,066	,000	,29	,63
	TNW	,210*	,062	,004	,05	,37
TNW	BMS	,228*	,049	,000	,10	,35
	ET	,248*	,055	,000	,11	,39
	EWI	-,210*	,062	,004	-,37	-,05

*. The mean difference is significant at the 0.05 level.

As table 14 illustrates, almost all faculties seem to be significant different from each other. Only for the faculties BMS and ET there does not seem to be a significant difference in the satisfaction with authority of choosing the learning methods. Although all faculties seem to differ from each other, they do seem to follow the same trend of a decreasing mean-score. As mentioned earlier the decrease in satisfaction with this indicator after the implementation of TEM is significant.

§5.9. Conclusion

As discussed in the previous paragraphs, the level of satisfaction with the indicators is positively influenced by the implementation of the new educational model. At the UT-level, each indicator shows significant differences in the level of satisfaction after the implementation of TEM except for the indicators guidance/counselling provided by the teacher and teacher-feedback. The satisfaction with collaboration, teacher-involvement and active learning has increased after the implementation of TEM. The satisfaction with the authority a student has in selecting the learning method has significantly decreased after the implementation of TEM. This is the only indicator that is negatively influenced by the implementation of the new educational model. The differences in the levels of satisfaction before and after TEM (at the UT-level) are summarised in table 15.

Table 15. Differences in mean-scores for satisfaction before and after TEM at the UT-level.

Indicators	**Pre-TEM**	**TEM**	**Difference**
Collaboration	4.03	4.21	+0.18*
Guidance/Counselling	3.69	3.71	+0.02
Teacher-involvement	3.75	3.81	+0.06*
Teacher-feedback	3.51	3.49	- 0.02
Active learning	3.32	3.44	+0.12*
Authority of student	3.15	3.01	- 0.14*

**difference is significant at 0.05 level*

The differences displayed in table 15 are at the UT-level. It is also interesting to investigate the changes in satisfaction levels for each indicator at the faculty-level. The changes in satisfaction levels for the indicators at the faculty-level are summarised in table 16.

Table 16. Differences in mean-scores for satisfaction by faculty.

Indicators	Faculty	Pre-TEM	TEM	Difference
Collaboration	BMS	3.90	4.12	+0.22*
	ET	4.45	4.43	- 0.02
	EWI	4.01	4.16	+0.15*
	TNW	4.06	4.21	+0.15*
Guidance/counselling	BMS	3.49	3.55	+0.06*
	ET	3.85	3.83	- 0.02
	EWI	3.85	3.80	- 0.05
	TNW	3.82	3.76	- 0.06*
Teacher-involvement	BMS	3.47	3.58	+0.11*
	ET	3.95	3.97	+0.02
	EWI	3.99	3.99	0.00
	TNW	3.90	3.88	- 0.02
Teacher-feedback	BMS	3.36	3.37	+0.01
	ET	3.59	3.56	- 0.03
	EWI	3.69	3.57	- 0.12*
	TNW	3.57	3,56	- 0.01
Active learning	BMS	2.91	3.08	+0.17*
	ET	3.71	3.64	-0.07
	EWI	3.60	3.83	+0.23*
	TNW	3.49	3.52	+0.03
Authority of student	BMS	3.01	2.87	- 0.14*
	ET	3.22	2.92	- 0.30*
	EWI	3.38	3.28	- 0.10*
	TNW	3.19	3.08	- 0.11*

*difference is significant at the 0.05 level.

Table 16 illustrates that the implementation of TEM has affected the faculties differently. The satisfaction levels for the indicator of collaboration at the faculty-level have increased significantly after the implementation of TEM, except for the faculty of ET. For the faculty of ET, the satisfaction level with this indicator has decreased, but this difference is not significant.

The satisfaction with the indicator guidance/counselling provided by the teacher has increased significantly at the UT-level. However, if we look at table 16 we see that only for the faculty of BMS the satisfaction score has significantly increased. For the faculties ET and EWI, there are no significant changes. If we look at the faculty of TNW we even see that the satisfaction level has significantly decreased.

The satisfaction with the indicator of teacher involvement has significantly increased after the implementation of TEM. Table 16 shows us that this positive effect is again only visible for the faculty of BMS, where the increase in satisfaction with this indicator is significant. The other faculties did not show significant differences for the indicator of satisfaction with teacher involvement after the implementation of TEM.

For the indicator of teacher-feedback there seem to be no significant changes in satisfaction at the UT-level after the implementation of TEM. However, table 16 illustrates that there is a significant decrease of satisfaction with this indicator for the faculty of EWI. The other faculties show no significant results.

The satisfaction with the indicator active learning has increased at the UT-level. For the faculties of BMS and EWI there is a significant increase for the satisfaction level with this indicator after the implementation of TEM. However, for the faculties of ET and TNW there don’t seem to be significant differences.

What stands out is that for the last indicator, the authority a student has in selecting their preferred learning method, all faculties show a significant difference in satisfaction after the implementation of TEM. It is interesting to see that for all the faculties there is a significant decrease in satisfaction with this indicator.

To conclude, the effects of the implementation of TEM seem to be positive, especially for the faculty of BMS. The mean-scores for satisfaction for the faculty of BMS appear to be higher than before the implementation of TEM, except for the indicator of satisfaction with authority. For the technical faculties the results are mixed, this might have something to do with the differences in assignment and learning environments between social and engineering faculties. Perhaps for most engineering faculties the learning environments and assignments were already better addressed, e.g. by laboratory work or scientific experiments. The results for the faculty of ET appear to be less positive, as for almost all the indicators the mean-scores for satisfaction have decreased after the implementation of TEM, except for the indicator of teacher-involvement. For the faculties of EWI and TNW the implementation of TEM has led to mixed results. The mean-scores for the indicators of collaboration and active learning have increased, where for the other indicators the mean-scores have decreased for the faculties of EWI and TNW.

§5.10. Analysing Dropout-rates

In this paragraph, I will analyse the dropout-rates of first-year students for the four different faculties. The dropout-dataset I use is provided by the UT. In this analysis, I have divided the respondents into six cohorts ranging from 2010 to 2016. This allows me to divide the sample into two groups: first-year students who studied before or after the implementation of TEM. In cohort 2013 the TEM was implemented, this is illustrated in table 17 by a horizontal line. In 2013 also the BSA instrument was implemented by the UT, which implied that during the first academic year at least 45 EC must be completed to continue the study programme. We therefore expect a higher dropout in the year of 2013. When comparing dropout rates before and after TEM this might lead to biased results, the year of 2013 is therefore not used in the final analysis.

The sample of students in the dropout-dataset is equal to the number of students who were registered as a first-year bachelor student at the UT in the period of 2010-2016. The bachelor students in the dataset all possess the necessary pre-university diplomas, which allow them to study at the UT. In my analysis, I will compare the dropout rate at the institutional (UT) but also at the faculty level. This allows me to discover if there are any significant differences in the dropout rates between faculties.

In this thesis, the dropout-rate is calculated by dividing the number of dropouts by the total number of students. The dropout-rate can be calculated at the UT and faculty-level. The dataset on dropouts for first-year students is provided by the University of Twente and allows us to investigate if the dropout-rate has changed after the implementation of the new educational model. The dropout rates are calculated by dividing the total number of dropouts by the number of first-year students at the UT level. An overview of the total number of first year-students, the number of dropouts (of first-year students) and the dropout rate at the UT-level is summarized in table 17.

Table 17. Dropout for first year students at the UT-level.

Cohort	*(N) first-year students*	*Dropouts*	*Dropout-rate at the UT-level*
2010	1302	282	21.66%
2011	1508	353	23.41%
2012	1418	338	23.84%
2013	1469	422	28.73%
2014	1452	363	25.00%
2015	1327	305	22.98%

Table 17 illustrates that the number of dropouts increases to 422 in cohort 2013. In line with the increase in the total number of dropouts, the dropout-rate increases from 21.66% in cohort 2010, to 28.73% in cohort 2013. This could be the result of the effect of the implemented BSA instrument. In cohort 2014, we see that the dropout-rate decreases again to 25% and to 22.98% in cohort 2015. In addition to the dropout at the UT-level, it is also important to analyse how the number of dropouts are divided between the faculties and what the dropout-rates are for the different faculties. At the faculty level, the dropout rates are calculated by dividing the number of dropouts by the number of first-year students who were enrolled in the faculty. An overview of the dropout rates at the faculty-level is given in table 18.

Table 18. Dropout of first-year students at the faculty-level.

Faculty	*Cohort*	*(N) 1st-year students*	*(N) Dropouts*	*Dropout-rate at faculty-level*
BMS	2010	611	150	24.55%
	2011	665	175	26.32%
	2012	618	183	29.61%
	2013	561	194	34.58%
	2014	524	134	25.57%
	2015	396	102	25.78%
ET	2010	239	42	17.57%
	2011	269	55	20.45%
	2012	264	45	17.05%
	2013	271	38	26.20%
	2014	279	86	30.82%
	2015	263	59	22.43%
EWI	2010	155	32	20.65%
	2011	210	46	21.91%
	2012	222	38	17.12%
	2013	241	67	27.80%
	2014	246	60	24.39%
	2015	265	59	22.26%
TNW	2010	307	58	18.89%
	2011	364	77	21.15%
	2012	314	72	22.93%
	2013	396	90	22.73%
	2014	403	83	20.60%
	2015	403	85	21.09%

If we compare the dropout-rate for the different faculties, we see that the dropout-rate decreases for the faculty of BMS after the implementation of TEM. The dropout-rate for BMS increases from 24.55% in cohort 2010 to 34.58% in cohort 2013. After which the dropout-rate decreases again to 25.57% in cohort 2014. From there, it slightly increases again to 25.78% in cohort 2015. For the faculty of BMS the dropout-rate increases in cohort 2013 but is lower than the previous cohorts of 2014 and 2015.

For the faculty of ET, the dropout-rate increases in cohort 2011, cohort 2014 and cohort 2015. The effect of the implementation of TEM is clearly visible for ET, in cohort 2014 and cohort 2015 the dropout-rate same for ET appear to be the highest. The dropout-rate decreases again in cohort 2015 to 22.43%. The faculty of EWI follows a similar trend, in cohort 2014 and 2015 it faces the highest drop-out rates. After cohort 2014 the dropout-rate for EWI decreases again to 22.26%.

For the faculty of TNW the effects of the implementation of TEM on dropout is less visible. In cohort 2011 and 2011 the dropout rate increases, but decreases again in cohort 2013 and 2014. The dropout-rate for TNW slightly increases again in cohort 2015.

To test if the dropout-rate for first-year students at the UT level has changed after the implementation of TEM I have created the following null hypothesis and alternative hypothesis:

H(0): there is no difference in the dropout-rate for first-year students before and after the implementation of TEM.

H(A): there is a difference in the dropout-rate for first-year students before and after the implementation of TEM.

As mentioned before, in 2013 the BSA instrument was adopted by the UT. The cohort of 2013 will therefore not be included in my dropout analysis at the UT and faculty-level. In the period before the implementation of TEM (cohort 2010-2012) the average mean for the dropout-rate for first-year students is 23.3%. After the implementation of TEM (cohort 2014-2015) this increases to 21.43%. The average mean for the dropout-rate decreased with 1.87%, however this difference is not significant.

This implies that we reject our alternative hypothesis, which indicates that there is no significant difference in the dropout-rate for first-year students at the UT-level.

It is also interesting to investigate if there are significant differences in dropout-rates before and after the implementation of TEM at the faculty level. The differences in dropout-rates before and after the implementation of TEM for the faculties are displayed in table 19.

Table 19. Differences in dropout-rates before and after TEM by faculty.

Faculty	Mean dropout-rate pre-TEM	Mean dropout-rate after TEM	Difference
BMS	26.83	25.68	- 1.15
ET	18.34	26.63	+8.29
EWI	19.86	23.33	+3.47
TNW	20.99	20.85	- 0.14
UT-level	23.30	21.43	- 1.87

*is significant at the 0.05 level.

As illustrated in table 19, at the UT-level we see a decrease in dropout after the implementation of TEM. At the faculty level, we see that for the faculties of BMS and TNW, the dropout rates decreased. The results on the faculty level are not significant and for the faculties of ET and EWI the dropout rates seem to have increased after the implementation of TEM. Since the faculty of BMS together with the faculty TNW have the biggest share of first-year students, the dropout rates at UT-level also have decreased after the implementation of TEM.

Although the dropout-rates at the faculty-level did not significantly change after the implementation of TEM, we can still analyse if the differences between the dropout-rates for the faculties are significant. The results are displayed in table 20.

Chapter VI: Conclusion

§6.1. Interpreting the Results

Through the analysis on the satisfaction with the indicators, we tried to measure if project-based learning, student-driven learning, learner-centred teaching and active learning are more present in TEM in comparison to the old educational model. As we have discussed in chapter V, project based learning can be measured through observing the satisfaction with collaboration, active learning and student-learning.

For the indicator of collaboration, the results are positive after the implementation of TEM. At the UT-level the increase in satisfaction with collaboration is significant. At the faculty level, almost all faculties except for ET (where no significant difference was found) are increasingly satisfied with collaboration. The results show that TEM had a positive influence on the satisfaction of the student with collaboration. This implies that there is more (effective) collaboration between students after the implementation of TEM.

The implementation of the TEM had a positive effect on the satisfaction with active learning. At the UT-level the satisfaction with active learning significantly increased after the implementation of TEM. At the faculty-level, the faculties of BMS and EWI also showed a significant increase in the satisfaction with active learning. Only for the faculty of ET there was a small decrease (-0.07) in the satisfaction with active learning, however this decrease was not significant. Overall the satisfaction with active learning has increased after the implementation of TEM. To conclude, we can say that within TEM there is a higher level of active learning.

What stands out is the decrease in satisfaction with student-driven learning. The results show a significant decrease at the UT-level, but also for all level faculties the decrease is significant. This is an unexpected outcome, as the TEM is more focussed on student-driven learning in comparison with the old educational model. This means that the intention of TEM was to give the student more authority in choosing their preferred learning method. However, the results showed that after the implementation of TEM the students are increasingly dissatisfied with the level of student-driven learning.

To test if there is a higher level of learner-centred teaching in TEM we have tried to measure the satisfaction with the teacher-student relationship. As mentioned earlier, the teacher-student relationship is measured through satisfaction with guidance/counselling, teacher-involvement and teacher-feedback.

The satisfaction with guidance/counselling has not changed if we compare the satisfaction levels before and after TEM at the UT-level. At the faculty-level however, a significant increase of satisfaction with guidance/counselling can be found for the faculty of BMS. Another significant difference can be found for the faculty of TNW, it appears that the students of TNW are less satisfied with guidance/counselling after the implementation of TEM.

To continue, the satisfaction with teacher-involvement has significantly increased at the UT-level. However, on the faculty-level, it showed that only the faculty of BMS showed a significant difference in the level of satisfaction with teacher-involvement after the implementation of TEM. For BMS the satisfaction with teacher-involvement increased significantly where for the rest of the faculties there were no significant differences to be found.

For the indicator of teacher-feedback there was no significant difference in the level of satisfaction at the UT-level. However, results at the faculty-level showed that students from the faculty EWI were less satisfied with the quality teacher-feedback after the implementation of TEM.

At the UT-level the satisfaction with the teacher-student relationship has increased after the implementation of TEM. Although this effect is not as significant as with project-based learning, we can say that there is more learner-centred teaching within TEM.

The faculty of BMS scores best on almost all indicators, except for the indicator of student-driven learning. This implies that for the faculty of BMS the implementation of TEM could have improved dropout, thanks to a higher level of efficient collaboration, a higher quality of teacher-student relationship, more active learning. In addition, the dropout-rate analysis showed us that the average dropout-rate for BMS has decreased after the implementation of TEM.

The faculty of ET has the lowest satisfaction scores on the indicators. This implies that after the implementation of TEM the faculty of ET experienced a lower level of efficient collaboration, a lower quality of teacher-student relationship, less active learning and a lower level of student-driven learning. In addition, the faculty of ET also has the biggest increase in the average dropout-rate. The average dropout-rate for ET increases with 8.29% after the implementation of TEM.

For the faculties of EWI and TNW the implementation of TEM has led to mixed results. The satisfaction scores for the indicators collaboration and active learning have increased, while for the other indicators the satisfaction scores have decreased after the implementation of TEM. The average dropout-rate increased for the faculty of EWI but has decreased slightly for the faculty of TNW. The results at the UT-level show that the dropout for first-year students decreases after the implementation of TEM.

I have summarised the changes in dropout, together with the changes in satisfaction with the indicators after the implementation of TEM in figure 20. To conclude, the results of the analysis on dropouts and the indicators show that the implementation of the new educational model had a different impact on each faculty.

Table 20. Differences in dropout rates and satisfaction after TEM.

Level	Dropout-rate	Indicators	Satisfaction
UT	- 1.87	Collaboration	+0.22*
		Guidance/counselling	+0.02
		Teacher-involvement	+0.06*
		Teacher-feedback	-0.02
		Active learning	+0.12*
		Student-driven learning	-0.14*
BMS	- 1.15	Collaboration	+0.22*
		Guidance/counselling	+0.06*
		Teacher-involvement	+0.11*
		Teacher-feedback	+0.01
		Active Learning	+0.17*
		Student-driven learning	-0.14
ET	+8.29	Collaboration	-0.02
		Guidance/counselling	-0.02
		Teacher-involvement	+0.02
		Teacher-feedback	-0.03
		Active Learning	-0.07
		Student-driven learning	-0.30*
EWI	+3.74	Collaboration	+0.15*
		Guidance/counselling	-0.05
		Teacher-involvement	0.00
		Teacher-feedback	-0.12*
		Active Learning	+0.23*
		Student-driven learning	-0.10*
TNW	-0.14	Collaboration	+0.15*
		Guidance/counselling	-0.06*
		Teacher-involvement	-0.02
		Teacher-feedback	-0.12*
		Active Learning	+0.03
		Student-driven learning	-0.11*

§6.2. Limitations of this study

The overall results described in the previous paragraph knows its limitations as well. To begin, the effect of the educational model on study success has not been discussed to a large extent in existing literature. The results of this study are therefore hard to generalize and further academic research should be done on the effect of the dimensions of the educational model on study success.

A second weakness is that together with TEM the BSA instrument was also implemented. The BSA instrument might also have influenced the dropout for first-year students after 2013. However, this research has shown that the organisational changes are felt by the student, as showed in the previous paragraph the satisfaction levels with various indicators have improved. This implies that aside from the BSA instrument, students are also affected by the organisational change that came with the implementation of TEM.

This leads us to the third weakness of this research. For the indicators of assessment and the learning goals and their effect on study success, no clear causal relationships have been found. Since my research tries to conceptualize the dimensions of the educational model, it is hard to relate all variables to study success. In the results of this research I did not include the effects of the changed learning goals and assessment methods. More academic research must be done on the effects of for example integrated assessment on study success.

The time-span of this research can also be a limitation of this research. The new educational model has been implemented in 2013 so its effects might be more visible on the long run. It is also interesting to investigate if there are significant changes in the dropout-rates for second and third-year bachelor students. In addition, other context variables might have also intervened in the causal relationship between the educational model and study success.

An important contextual factor that might have influenced the dropout decision of the student in the period of 2010-2016 might be the introduction of the Dutch loan-system (‘leenstelsel’) in 2014. This new regulation implied that students who started their studies at a higher education institution in the Netherlands no longer received subsidy from the state to pay for their study costs (Interstedelijk Studenten Overleg, 2016).

All the weaknesses have one thing in common: it remains difficult to operationalize how the dimensions of the educational model can affect study success. In addition, to effectively operationalize the indicators that affect study success future research should determine whether relationships are positive or negative and how strong these relationships can be. Through this realization, I hope that more research will be done on the effects of the educational model on the dropout decision.

§6.3. Conclusion and recommendations

In this paragraph, the main research question and sub-questions will be answered. The first sub-question was: ‘What factors influenced study success?’. As we have seen in our analysis, TEM mainly affects dropout through two dimensions: the learning environment and the strategy object. These two dimensions can improve social and academic integration which has a positive influence on the dropout decision. In addition, the sense of belonging can also directly affect the dropout decision.

The second sub-question was: ‘Which elements of TEM can improve study success?’. As we have seen TEM can increase study success through project-based learning, student-driven learning, active learning and learner-centred teaching. The BSA instrument that was also implemented together with TEM can negatively affect dropout on the short term. However, in the long run the BSA instrument might prove to positively affect study success as it filters out students who are a perfect fit for their study programme.

To continue, the third sub-question was: ‘Are these elements more included in TEM in comparison with the old educational model?’. As mentioned earlier, project-based learning can be measured through the indicators of collaboration, level of active learning and student driven learning. In this thesis, we tried to measure the presence of these indicators by looking at satisfaction levels with the indicators. An increase in satisfaction illustrated that the indicator is more present in the new educational model. For collaboration and active learning, the satisfaction levels have increased after TEM. This implies that there is indeed an increase in project-based learning.

However, it appears that student-driven learning is less present in the new educational model. The satisfaction levels for this indicator have significantly decreased after the implementation TEM, both at the UT and faculty level. This is an unexpected outcome as TEM wants to be student centred but is less perceived so, this could be e.g. a result of the fact that there are less optional courses within a module.

Learner-centred teacher is measured through the satisfaction with the student-teacher relationship. Our analysis has shown that for the indicators: guidance/counselling and teacher-involvement the satisfaction levels have increased after TEM. The satisfaction with teacher-involvement has significantly increased at the UT-level, this is most likely the result of the teacher adopting the role of tutor in projects within TEM. Only the satisfaction with teacher-feedback seems to have decreased slightly, however this difference is not significant. The results indicate that there is more learner-centred teaching within TEM in comparison to the old educational model.

The fourth and final sub-question was: ‘Is there a significant decrease in dropout after the implementation of TEM?’. As shown in figure 20, the dropout has decreased at the UT level, but this is no significant difference. At the faculty level, the dropout rates for BMS and TNW have decreased, where the dropout rates for ET and EWI have increased. However, the differences were also not significant at the faculty level.

This brings us to the main research question of this thesis: ‘Does the Twente Educational Model improve study success and which factors contribute to this result?’. Since there is no significant difference in dropout, it is hard to argue if TEM improved study success. However, our analysis has shown that the dropout rates are decreasing. This might be the result of an increase in project-based learning, active learning and learner-centred teaching within TEM. To conclude, the musical of TEM seems to have a happy ending, however more longitudinal research should be done on TEM to monitor its effect on study success. In this thesis, the dropout rates of first-year students are used for the analysis, but it is also interesting to investigate the effect of TEM by observing dropout rates for second and third-year bachelor students.

By comparing TEM with the old educational model, this thesis has illustrated that through the dimensions of the strategy object and the learning environment dropout can be affected. Within TEM, the strategy object includes more project-based learning, more active learning and more efficient collaboration between students in comparison with the old educational model. These variables, that were more integrated in TEM, had a positive impact on dropout. In addition, TEM also focussed more on the learning goal of the integration of knowledge, where students integrate their new knowledge in everyday life. This stimulates effective learning and therefore also has a positive effect on dropout. Changes in assessment and its effect on dropout is hard to measure, since there is no academic literature on the causal relationship of assessment and study success.

The dimension of the learning environment has also changed with the implementation of TEM. The contact of students with other students is positively affected by an increase in collaboration and active learning activities, such as having open debates and discussions during lectures. The teacher-student relationship has also improved through an increase of learner-centred teaching and the teacher adopting the role of tutor, in steering and guiding the project. The sense of belonging is also positively affected by collaboration and active learning, through an increase in project-based learning.

In addition, this thesis has shown that policies aimed at the organisation of higher education can indeed improve study success. For future research, the framework of the educational model as conceptualised in this thesis can be used in order organise and improve study success at higher education institutions. An increase of project-based learning, active learning and learner-centred teaching can lead to an increase in study success. To conclude, if more research is done on the indicators of the educational model and its effects on study success, case studies should show that organisation of higher education can indeed enhance study success.

All of this should finally lead to a better understanding of the educational model and its effect on study success. Current educational models are often out-dated or no longer adequate and fall short in guaranteeing study success. Improving study success is not only beneficial for the student, but also for the higher educational institutions. It is therefore important to start with analysing new ways of applying indicators that enhance study success.

In March 2017, there was an open debate for the students and staff of the UT on the implementation of TEM. The main outcome of the debate was that the aims and goals of TEM were adequate, however there were still some practical issues with the implementation of TEM (Kuijpers, 2017). The implementation process of TEM had not been an easy process, since a decent part of the implementation method was left open to the faculties and study programmes. This may have resulted in an unstructured and chaotic implementation process. Regarding the multidisciplinary dimension of TEM (students of different study disciplines can follow the same modules), it might be better to implement TEM more universally throughout the different study programmes.

Another issue that was discussed during the debate was the absence of flexibility within the modules. It was suggested that modules should be separated in separate smaller modules. However, the integrated modular design of TEM together with the application of project-led education, as shown in thesis can contribute to effective learning and can lead to an improvement of study success.

For now, I would like to close the musical of TEM with the classic song ‘wind of change’ of the Scorpions, since the staff and students of the UT are increasingly aware of TEM and its positive effect on study success. TEM started as a ‘storm’ in 2013, after which a storm (with winds of changes) has been raging over the UT. Now the storm has finally passed; the students and the university staff have increasingly embraced the organisational changes of TEM.

Chapter VII: References

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