

# **A qualitative inquiry into first year engineering student success.**

**M.E.D. van den Bogaard**

Delft University of Technology, Delft, the Netherlands

m.e.d.vandenbogaard@tudelft.nl

***Abstract:** Student success, drop out and progress are hot issues in most schools of engineering. The problem of high drop out has been looked at many times, with researchers using similar dependent variables like progress, grade point average or persistence. In this study we explore whether students perceive success in terms that are similar to how it is commonly operationalized. We also explored to what facets of student life students attribute their success or lack thereof. We interviewed groups of engineering students multiple times during their first year in university. Major findings include that students define success in a less stringent way than researchers do and students attribute their success largely to commitment to continue to spend time, to their motivation and their focus on goals that help the students focus their attention.*

## **Introduction**

Issues of student success, student retention and progress, are present in most universities of engineering and technology (e.g. Ohland et al., 2008). Delft University of Technology (DUT) is no exception. Over the past 50 years this university has attempted to increase the attainment rate and to reduce the time to graduation of its students. When we look at these indices for the past years, it is evident that these attempts have not been very successful: the first year drop out rate lies between 35 and 50 %, and the average time to graduation for a 5-year programme (bachelor and master) is 6,9 years. These numbers proved to be very hard to change. To understand why it is so difficult to influence student success the university commissioned a research project. It was decided to focus on the first year of engineering education only as a number of researchers determined that first year success is of paramount importance for persistence in engineering (e.g. Crissman & Upcraft, 2005).

## **Research questions**

Student success is among the most widely researched areas in higher education. Researchers have studied the issue in many different contexts, testing different models covering a variety of variables. Outcomes of these studies are often ambiguous; variables have different effects in different contexts or sometimes no effect at all. In this project the first step is to develop a situated model of first year student success in DUT and the first step towards such a model is to establish how students perceive student success and what aspects of studying they believe contribute to their success. We pose the following research questions:

1. How do first year students perceive success in their studies?
2. Which elements of student life are perceived to be of importance for success by the students?

## **Findings from research into student success**

As stated in the previous paragraph, much research has been done in this specific area of interest. Developments and major outcomes of this research can be found in e.g. Upcraft, Gardner and Barefoot (2005). For engineering student success specifically there is no synthesis of work done in the field so far, but over the past decade the number of rigorous

studies in this field has grown considerably, e.g. Seymour & Hewitt (1997), Ohland et al. (2008) and Van der Hulst & Jansen (2002).

From this body of work a number of variables that are related to student success emerged. Student background variables including ability, age, gender, parental level of education and ethnicity were found to have effects on success, just like interpersonal interactions with fellow students and academic staff (Crissman & Upcraft, 2005). Institutional variables, e.g. curriculum organisation, also have effects. Van der Hulst and Jansen (2002) found that students in curricula with few parallel courses for which students are awarded a fair amount of credits are more successful than students in curricula with a large number of small courses.

## Methods

The literature review yielded many different variables that are related to success. However, the aim of this research is to find out how first year students perceive success and to which aspects of student life they attribute their success. We decided to interview students several times during their first year. We chose to do focus group interviews using the storyline technique.

### Focus groups and storylines

Krueger (1994) stated that focus groups can capture the dynamic nature of group interaction and create a social context that is more natural to respondents than individual interviews. It allows respondents to react to each other's views and experiences and this generally generates a shared range of opinions that are present in the group. Extreme opinions are easier to detect, as respondents can bring up their experiences to contrast opinions they do not recognize.

In the first interview the students shared their first impressions. In the follow up interviews they were asked to look back at their experiences in the university by using a visual technique called 'storylines'. This technique was first described and tested by Gergen (1988) A storyline is a two-dimensional graphic representation that shows a student's experience on a time line (x-axis). Students were asked to think of those events that marked their experiences of the course of a semester and to indicate what effects these events had on their university experience (y-axis). This technique helps to gauge to what extent events were perceived positively or negatively by the students. Another benefit of this technique is that it provides the students with a visual and something to do and focus on something other than the researcher. According to Gergen (1988) this technique makes it less confronting for respondents to discuss potentially sensitive topics.

### Sampling

Students from Applied Physics (PH), Mechanical Engineering (ME), Aerospace Engineering (AE) and Policy Analysis (PA) were recruited in September 2009. Existing student mentor groups were approached for participation. These groups were assembled randomly by the programmes and a basic level of trust was already present in those groups, which was an advantage for focus groups. Participation in the interviews was voluntary. Students received a letter with information on the research and a consent form. Interviews were scheduled in breaks so they would not overlap with any education activities. Lunch was provided.

With the PA and PH students it turned out to be impossible to meet in the first semester. These groups participated in two interviews only. Not all the participants attended all the sessions, but all sessions were attended by at least three students. In this paper all names have been changed to ensure anonymity of participants. The substitute names of students in ME start with M, in PA names start with P, in AE with A and in PH with H. In this paper 'programme' refers to a curriculum and 'course' to a unit within a curriculum.

## Coding

We transcribed all the interviews verbatim and analyzed the data using the Atlas TI software package. A codebook was created in an iterative process. First all transcripts were read carefully and coded using generic codes proposed by Miles and Huberman (2005, page 61). All transcripts were recoded using codes that referred to the setting the students related to. These 'setting codes' were based on the literature review and on a first reading of the transcripts. Next, all the categories were coded again using open coding. These open codes were revised and combined until there was a consistent set of codes. By using this diverging strategy we aimed to prevent bias through code development.

## Results

We asked students about their success intentions for the first year and for later years in all three interviews. Success intention was taken as intention to pass all 60 credits of the first year in one year (this is referred to as P-in-1, between 10 and 35% of the students obtain 60 credits in their first year), how students perceived the reenrollment requirement of obtaining at least 30 credits in the first years and how they perceived drop out. Three general categories of success intention were identified.

1. P-in-1 as a beacon: Several students state that the P-in-1 is a beacon, a higher goal. They strive for it, but they do not find it a big deal if they do not make it. There are two lines of argumentation underneath: 1) It can't be done anyway. Harald says that this believe that it cannot be done permeates all levels. At PH all students meet with academic staff members a number of times in the first year and Harald felt this person tried to temper his ambition, although Harald passed all his courses with high grades. 2) Students do not know if this level of achievement is for them. Andrew says in the first interview he will start setting clear goals after the first round exams, not before.
2. P-in-1: so what!? Andrew states that he feels passing the test is less important than understanding the coursework. Matt is committed to becoming a mechanical engineer, but he prefers to take his time. If that means that he will take 6 years or slightly more, he is fine with that. The P-in-1 may still serve as a beacon for these students.
3. P-in-1: go for it! Some students feel that, since they need to pass these first year courses anyway, they prefer to get it over with. Some students have other motivations to want to pass the first year. For teaching assistantships and certain board positions a student needs to have obtained the first year diploma.

The students were asked for their aspirations regarding obtaining the bachelor diploma in three years. None of the students seemed to care. First they want to find out how they can be successful in university, pass the 30 credits reenrollment requirement and pass the first year.

From the open coding three other aspects of success emerged. These are described below.

- Feeling good about performance: Mary states that she has to make an effort to start preparing for the exams, but *"it gives a kick when you look back when you passed all the exams after having given it your all."* Harald shares this feeling: he feels satisfied when he has worked hard and is rewarded with good grades. His peer group is very committed and there is competition for high grades. For Harald this is a source of motivation.
- Getting up after a fall: Hugo and Marc were confronted with not passing their exams. Hugo failed all of his exams in the first period of the year; Marc failed all but one in the second period. Both failed because they felt that the topics that were covered were very easy and they did not need to put in a lot of effort. Both managed to make up for this fall by working consistently hard during the next period and focusing all their attention and effort on achieving their goals. Hugo states that he felt 'ecstatic' when he found out that he had passed all his exams in the second period, even though he passed some with the

minimal pass mark. Marc was set on passing as many courses he could and felt good about this.

- Having a rich student experience. Matt is most explicit about this, but Hannah and Mary mention it as well. They want more from student life than studying alone. They state that their side activities and the diversion help them keep up their motivation. Side activities can be very rewarding too and it is a great way to meet people outside the programme.

How do students perceive drop out? This question was pursued by asking students how they felt about friends dropping out of university and how they perceived the letter that informs them about their progress in the second education period.

Marcel states clearly in the first interview: *“You don’t know if this is for you. You need to commit yourself and if you still fail, that is okay. You know you have given it your best and you can leave with your head held high.”* Alex, Matt, Hannah and Howard state that they learned early on that many students drop out. They had heard this from fellow students, students at their fraternities or read it on the website. Hannah: *“You just hear people talk about it, that 50% drop out in the first year so you take that as a fact.”*

In follow up interviews students report different experiences. The PA students know that people drop out, they just do not know anyone who did and it puzzles them. They conclude that the dropouts are the people who never come to class. The students at ME lost some group members. One of them left right after the first round of exams, but he never bothered to inform the team and they needed about two weeks to find out. The students were surprised he left: they had not seen it coming. The students gone missing were replaced quickly, the project was unhurt and the students got over the incident quickly. The team at AE lost three students. The students talk negatively about one person. Alex says: *“She quit at the beginning of the second educational period. She did nothing, she attended project meetings because it was mandatory, sitting there with her head down. ... She was no good at all.”* Alice contends with this statement. The students who tried hard are talked about in a matter of fact way. At PH Hannah, Howard and Harald see students struggle, but it does not seem to affect them. Neither did the letter informing them about their progress.

The students who had been at risk at some point have different experiences. Malcolm admits in an interview that he is struggling and he found out that ME is not for him. He went to see the support officer but did not get the support he wanted. Prue had not passed many exams and received a letter in which was stated that she was at risk and she needed to work harder. She felt cheated, because she had tried hard but it just had not happened for her. For Hugo the letter was a real blow: having failed dramatically he felt bad enough already and he felt the letter informed him he was considered a basket case. The letter also served as a wake up call because it formally confronted Hugo with the fact he had passed none of his exams. Hugo is affected by the fact that some of his friends left the PH programme. In the third interview Hugo says he feels proud he recovered from his fall and that he will continue in PH. It seems to him as if there is a separation between students who do well and those who struggle, but this separation is hard to notice it as failure and struggle for success are not discussed openly. Harald disagrees and states that: *“Everyone in PH likes the programme and is committed to their own success.”* Harald thrives due to the competitiveness in PH as remarked earlier. Marc failed in the second period and he does not mention the letter, but he states that to him the failure felt like a blow and wake up call.

In conclusion of this section, it is observed that failure is not openly discussed among students. Dropping out is not talked about as something that is negative per se, but a lack of commitment is. The students who need support do not seem to get the support they would like. It is not something that seems to impact the students who stay, or possibly students decide not to waste time on it. All the other students talk about working hard and they attribute their success to their commitment to putting in effort.

The students were also asked which events influenced their experience as students and how. Five codes relevant to educational climate were identified: perceived quality of teachers, assessment and organisation of campus, curriculum and courses. These codes were explored using open coding and the open codes were revised and combined until there was a consistent set of codes. The number of instances that the open codes were used were counted and assessed on whether it was laden with a positive or negative value. A small number of topics score persistently negative: 'curriculum organisation', 'quality of assessment', 'high course load' and 'fluctuations in course load'. 'High course load' and 'fluctuations in load' seem to contradict: students state that they spend long hours taking lectures and on independent study. When they also have lab and project work, they still need to attend lectures and keep up with their classwork and spend long hours working on practical work. The students in PH, AE and PA find it very difficult to combine these activities.

Most topics educational topics have mixed loads: some aspects are talked about in a negative way, other aspects of the same topic in a positive way. An example is 'Teacher's personal style'. Typical negative statements include: Teacher rushes class, does not listen to critique, is sarcastic, teacher is neither enthusing nor passionate, explains in an unstructured way. Typical positive statements are: Teacher appeals to and captivates students, is involved, shows passion for the subject, is authentic, takes students seriously, points out relevance of topics, structures and paces very well. Students surprisingly made contradicting remarks about the same course.

Besides codes that had to do with educational attributes, the students also mentioned a number of personal attributes that matter to their success. 'Students' social environment' is mentioned 29 times. All aspects of social environment have mixed loads on the students. Fraternity membership is motivating, but it costs a lot of time too. Next to 'student social environment' most statements have to do with 'time spent' and 'reflection'.

There are 25 statements on how students spend their time. Most of the students try to keep up with lectures and revise everything in the lecture free periods before the exams. Keeping this regime up requires a lot of discipline from most students. Planning is found to be important. Even Matt makes schedules for studying. He also plans time for his other activities. The amount of time students put in depends on how much time they have on their hands and on how important they feel it is to keep up with class work. If keeping up has served the student well, she will probably try to maintain this strategy. If keeping up has proven not to be necessary, a student will not change her ways until it goes wrong. The gap between secondary school and university is a part of this as most first year students are not used to working hard.

Most of the students cannot study all the time, at some point they need a break: they go on holidays, organize events, work out, do something to break routine. New courses and new approaches (practical work) help to renew/ maintain motivation and continue to work hard. Another source of distraction are fraternity, student association or activities that underline the opportunities in engineering. Examples are presentations of future employers or documentaries on Discovery Channel<sup>TM</sup>.

## Conclusions and reflections

The first research question is: How do students perceive success? Students see passing courses, and therefore progress, as 'success'. Students also experience success when they achieve personal goals. These personal goals range from desire for deep learning to getting high marks to wanting to have a rich student experience with many side activities. A lack of success is a reason to give up for some students, for other students it creates the necessity and drive to achieve. Failing and dropping out seem to be viewed as facts of life, but not being committed to engineering is frowned upon.

The second question is: Which elements of student life are perceived to be of importance for success by the students? The most important elements are effort and discipline. Student related factors that influence success have to do with motivation to stick to a successful

strategy and spending the time necessary to study for the tests. Every student develops a strategy that works, even if it creates pressure. Sometimes it works because it creates pressure. Most of the students report that they go to lectures regularly and pay close attention. There is consensus among the students that this regime is helpful for being successful. Even if students do not manage to keep up with class work, they have covered the materials by listening and making notes.

The consistently high course load is tough on the students. Alice, Alex and Andrew report fatigue, depression and other physical problems they attribute to the overloaded curriculum. Students in PH report on the fluctuations in study load: they spend long hours in the lab and during the weeks they have practicals, they feel there is no time to keep up with the work required for other courses. The PA students report that they feel they only have time to keep up with course work in periods with no projects scheduled. Other elements that influence student success have to do with the support of a peer group and with teachers' personal style and didactical expertise. When teachers manage to appeal to students and create a fostering learning environment, this helps the students to put more effort into it. However, a teacher who is greatly appreciated by one student could induce resistance in another. The students do share experiences of didactical expertise. Teachers who structure their lecture well and who are enthusiastic about their topic are appealing to all students. These teachers usually have good course materials available that can be understood easily when the student has been to class. Students attribute most of their success to 'working hard'. Talent, curriculum organisation and teacher quality have its' effects, but according to the students success really comes down to the willingness to put in the necessary time and effort.

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