

# Student drop-out in the Engineering Sciences

Multi-university analysis  
and recommendations

acatech (Ed.)



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High drop-out and attrition rates on engineering science courses pose a major challenge for education policy, not only because of the skills shortage but also because of the high costs in terms of economic and human resources. Universities and policymakers must take appropriate, coordinated measures (programmes inside and outside of universities, improvements to the overall framework) to increase the proportion of engineering science students who successfully complete their studies whilst maintaining the high standard of education provided. In order to do so, they require robust data on attrition and drop-out rates.

This joint project of acatech and TU9 used cohort tracking data for multiple universities and subjects to produce the first quantitative review and analysis of its kind. Based on this and their own experience, representatives of the participating (technical) universities discussed the factors and general framework required for students to successfully complete their studies. In addition, successful best practices for combatting attrition were identified, including aptitude assessments, online self-assessments and integrated study support programmes. The project's findings are summarised in an acatech STUDY (see panel).

For the first time, this study investigates when students drop out, as well as the differences between individual universities and subjects with regard to drop-out rates and the number of students who switch universities or subjects. Two of its key findings are that:

- **The majority of students who drop out or switch subjects/universities do so during the first two semesters.** This is a positive finding. Although there is still a fundamental need to reduce attrition during this period too, students should always have the opportunity to change subjects or the career they are studying for. Indeed, the decision to do so can often have a positive outcome if taken early on in their studies.
- **Significantly fewer students are leaving university without a degree than was previously thought.** This is revealed by a detailed breakdown of the attrition rates. At the end of the sixth semester, 6 percent of students have switched

subjects, while 10 percent have changed universities and 21 percent have given up their studies completely. After three further semesters, the corresponding figures are 7, 11 and 23 percent. There is hardly any variation in the figures for the different cohorts included in the study, and the percentages are also similar for male and female students. The only case where attrition is slightly higher is for foreign students (8, 11 and 26 percent). However, even though the

## At a glance

- A recent acatech STUDY found that although the drop-out rates on engineering science courses are significantly lower than was previously thought, they are still too high.
- The majority of students who drop out or switch universities/subjects do so during the first two semesters.
- Admission restrictions significantly reduce attrition provided that they select students with good *Abitur* grades. Aptitude assessments are the most effective instrument.
- The legal frameworks in the different federal states also affect successful study completion rates. The more freedom universities have, the lower their attrition rates.
- Universities and policymakers must take coordinated measures and data for multiple universities should be systematically analysed.
- Universities should make wider use of admission restrictions, support students who are just beginning their studies, improve teaching standards and share experiences in these areas.
- Policymakers should afford universities as much freedom as possible to establish their own study conditions and consolidate measures that successfully combat attrition.



drop-out rates are significantly lower than was previously thought, they remain too high and action is still required to bring them down.

Until now, statistical data covering multiple universities was primarily provided by the German Centre for Higher Education Research and Science Studies (DZHW). The results of the acatech STUDY cannot be directly compared with this data. As well as being based on a different statistical population/sample, the acatech STUDY analyses first-year student cohorts for the duration of their studies, whereas the DZHW estimates drop-out rates by comparing the number of students in a particular graduating class with the number who started the course. Importantly, the acatech data points to significantly lower drop-out rates than the DZHW statistics. Furthermore, there is substantially less variation in attrition rates between the different first-year cohorts in the study.

Other key findings of the acatech STUDY:

- **Attrition and drop-out rates are significantly lower on courses with admission restrictions than on courses without admission restrictions.** Aptitude assessments are the most effective instrument, although they are also very time-consuming. Moreover, all of Germany's federal states have strict legal restrictions on when aptitude assessments may be used – they are only allowed for subjects that require a special aptitude.
- **Admission restrictions only reduce attrition and drop-out rates if they lead to the selection of students with higher average secondary school leaving exam (*Abitur*) grades.** For average grades of around 2.3 or better, there is an almost linear correlation between *Abitur* grades and drop-out rates. For lower grades, on the other hand, the proportion of drop-outs tends to increase, but the correlation between *Abitur* grades and drop-out rates is significantly weaker.
- **There is significant variation in attrition rates between individual subjects, universities and faculties.** As a rule, the differences between individual universities are strongly correlated with differences in the legal frameworks of their respective federal states. Differences between individual subjects are explained by their respective cultures, teaching content and requirements, including the admission procedure. Significant differences between individual universities for the same subject are caused by local factors and should therefore be analysed in detail at a local level.
- **Some differences in drop-out rates can be clearly attributed to the legal frameworks in the federal states.** This is particularly true with regard to the freedom that universities have concerning admission procedures and study and

examination regulations. As a rule, the greater the number and scope of the measures permitted by state law, and the greater the take-up of these measures by universities, the lower the attrition and drop-out rates. Aptitude assessments, orientation exams and maximum study periods were shown to be the most effective instruments. Put another way, this means that it is not just the universities that are to blame for low graduation rates, longer study durations and high numbers of late drop-outs. In particular, it would be unfair to make university funding primarily conditional on performance indicators that the universities have little control over.

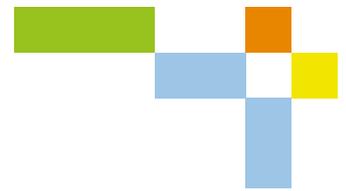
## Recommendations for universities and policymakers

acatech has formulated a number of recommendations geared towards achieving a lasting increase in the proportion of engineering science students who successfully complete their studies and in particular preventing late drop-outs. The successful implementation of these recommendations will require three conditions to be met:

- Universities must provide their students with a high standard of education right from the beginning of their courses, create an environment that promotes learning and foster successful study completion, if at all possible within the standard period of study.
- Students must approach their studies in a self-reliant, engaged and serious manner. If necessary, they should take advantage of the support services provided by the university on their own initiative. They should see themselves as active participants in the overall university system.
- Policymakers should afford universities as much freedom as possible to establish study conditions and implement measures that help students to successfully complete their studies.

## Recommendations for universities

1. **Take action on admission criteria, study conditions and the general framework**
  - **Make wider use of admission restrictions:** Attrition rates tend to be lower on courses with admission restrictions than on courses without them. Aptitude assessments have been shown to be the most effective admission procedure.
  - **Support students who are just beginning their studies:** Students mostly drop out or change subjects/universities during the first two semesters of their degree course.



Appropriate measures can prevent avoidable switching of subjects/universities and in particular drop-outs.

- **Help late drop-outs to find alternatives:** In the engineering sciences, there is a slight increase in attrition at the start of the fifth semester of the degree course. Since this phenomenon entails high costs for both students and universities, specific measures should be taken to address it. Industry can help by offering these students alternatives.
- **Pay more attention to what other regions are doing:** Universities should compare their data and engage in detailed discussion of study conditions and measures to enhance learning and teaching quality. Learning about others' experiences can help universities to improve their own services and motivate them to negotiate better general conditions with their state education ministry.

## 2. Improve curricula and teaching standards

- **Optimise teaching standards:** All the stakeholders share the responsibility for this.
  - **University management and faculties:** More explicit focus on teaching when making appointments, support for teaching skills development and tutor training, funding and establishment of bridging courses;
  - **Faculties/responsible departments:** Continuous review of course curricula and optimisation of all courses;
  - **Universities:** Systematic use of a quality management system (QMS) that addresses all these issues. This should also include regular evaluations of the effectiveness of any measures taken;
  - **Policymakers:** Create more flexibility, e.g. by improving student-teacher ratios and avoiding micromanagement (such as regulating compulsory attendance and the number of exams).
- **Give curricula a more practical focus:** The curricula of STEM subjects in particular are frequently criticised for an overly theoretical focus during the first semesters of the degree course. There is a need for content that illustrates the practical applications of the knowledge being acquired. In addition, faculties and teaching staff should regularly review course content with business actors and industry associations and, where necessary, work with them to give curricula a more practical focus that better meets the needs of businesses.

## 3. Ensure accuracy of drop-out figures and implement quality management system

- **Better data for a better understanding of drop-outs:** Data must be as exact as possible in order to gain a better

understanding of drop-outs at a particular university or in a particular subject, describe the problems accurately and take the appropriate countermeasures. Accordingly, universities should collect data with a view to carrying out cohort analyses. Attrition should be recorded systematically and in as much detail as possible, in order to assess the effectiveness of any measures taken.

- **Interpret data in context:** The interpretation and contextualisation of individual universities' data and information should be integrated into a quality management system (QMS). This is key to the targeted use of the data and the implementation of effective measures.
- **Provide individual student monitoring to identify and address problems as early as possible:** First-year students in particular often find it difficult to organise their studies, manage their time and prepare for exams. Individual monitoring can help to identify problems and ensure that students are directed to the relevant advisory service as early as possible. Universities and faculties must persuade students to take advantage of these services.

## Recommendations for policymakers

### 4. Relax the legal constraints on universities

- **Allow universities more freedom to select students:**
  - **Aptitude assessments:** Attrition rates tend to be significantly lower on courses with admission restrictions than on courses without them, especially when aptitude assessments are carried out. The law should therefore allow universities to carry out aptitude assessments for courses based on the specific (regional) needs of the course's profile.
  - **Extend conditional admissions to Bachelor's courses:** As part of a data-based portfolio of measures, universities should be allowed to extend conditional admissions to Bachelor's courses (they are already common practice for Master's courses). However, this instrument should be used with care, since in some cases it can be very time-consuming.
- **Give universities the freedom to create conditions conducive to success:** Universities should be able to establish their own university-specific study conditions based on robust data and information. The acatech STUDY outlines some of the regulatory parameters that affect the number of students who successfully complete their studies.
- **Allow students to study at their own pace:** Rather than having a limit of six semesters, students should be allowed to take seven or eight semesters to attain the competence



level of a current Bachelor's degree. Similarly, they should be allowed a further four semesters to complete a Master's degree. For the STEM subjects in particular, a large number of preparatory and bridging courses are available in a range of formats. However, since they only last a few weeks, they are often unable to bring all their participants up to the standard required to successfully start an engineering degree.

#### 5. Ensure that universities have the necessary financial resources

- **Consolidate measures that successfully combat attrition:** Most of the measures for combatting attrition – especially in the STEM subjects – are funded through one-off federal or state government programmes. The universities have to commit to continuing these programmes if they are successful. In practice, however, they cannot always keep them going in their entirety without detriment to other important measures. It is therefore recommended that there should be an option to make government funding permanent for programmes that are able to demonstrate their success.
- **Increase basic funding for universities:** As the German Council of Science and Humanities has repeatedly pointed out, the basic funding for universities is insufficient, particularly for their study and teaching activities. Consequently, universities have very little spare cash for additional measures, even though the increasing heterogeneity of students means that such measures are both in demand politically and objectively necessary. This is particularly true of costly measures such as aptitude assessments.
- **Reform performance-based funding:** Student drop-out is a complex phenomenon that calls for a nuanced approach. Policymakers must not lose sight of this if they are going to tie university funding to the percentage of students who successfully complete their courses. In particular, this means that the attrition rates should be adjusted for students who switch subjects or universities. The frameworks in the different states vary significantly in terms of the freedom that universities have to implement their own measures for preventing drop-outs and helping students to complete their courses within the standard period of study (or, if necessary, one or two semesters more).

### Methodological approach

The acatech POSITION PAPER *Student drop-out in the Engineering Sciences* is based on a study of the same name carried out by acatech in conjunction with the T9 and three other universities between 2015 and 2017. Data from several first-year student cohorts (50,171 cases in total) for five engineering science Bachelor's degrees was analysed in terms of differences with regard to drop-out rates and the number of students who switch universities or subjects. The participating universities were RWTH Aachen University, TU Berlin, TU Braunschweig, TU Darmstadt, TU Dresden, TU Dortmund, University of Duisburg-Essen, FAU Erlangen-Nürnberg, LU Hannover, Karlsruhe Institute of Technology (KIT), Technical University of Munich and University of Stuttgart. The project was funded by the Federal Ministry of Education and Research (BMBF).

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