

New University Education Structures: Challenge for the Future

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Abstract: This paper gives a brief look to the German education system and the change to new structures of engineers education on the base of the Bologna-process. The discussion has its focus to the structure at the Fachhochschule Furtwangen. A look to the advantages and disadvantages will close the presentation.

Keywords: Bologna-Process, Education of Engineers, structures of education systems

1. Introduction

In industrialized countries there is a long tradition of academic education. Different structures of education programs were developed and are part of the societies. In Europe we find today a wide range of academic programs, which are different in structure, duration, type of examination and graduation requirements.

Europe is turning more and more into a union. To be competitive in a global market and to educate successful global players, the universities of Europe have to restructure their education programs.

Some years ago, the member states of the European Union started a process to develop a common education system with a common structure and comparable degrees in Europe. We know this process as the “Bologna Process”, which has to be finished by 2010.

Europe is preparing a common education framework for a common market and for the market in a global world – a real challenge for the future.

2. Education in Germany

In Germany, education is under the control of the individual German states (Länder). The federal system only provides a framework. The result is an equal system within all of Germany at first glance, but with some differences in detail.

To gain university access, students need to reach an education level of 12 to 13 years of school; the graduation qualification is known as Abitur. We have different types of schools, which provide the required education. Children usually enter school (the first class of the elementary education) at the age of six. After 4 to 6 years, they transfer to secondary schools, of which there are three main choices:

- the “Hauptschule”, students leave after the ninth (or tenth) class (geared towards a more vocational education and job orientation)
- the “Realschule” (middle school), students leave after grade ten (geared towards an academic and possibly vocational education and – perhaps – a more administrative job orientation)
- the “Gymnasium” (grammar school), they traditionally graduate after grade thirteen (geared towards a universal academic education and administrative job orientation; preparation for university studies)

To join a university, students need to pass the final exams of the last school-type (Gymnasium). For those who leave the first two types of schools, and wish to move on to university, there is a “continued secondary education path”. This entails additional education courses which first have to be completed before university access is granted.

In Germany, we traditionally have two, today three different types of tertiary education institutions which provide advanced academic education:

- Universities based on research: These have a very long tradition – one of many centuries. They started with the arts, the humanities, medical education, law, theology and so on, and offer today a wide range of natural and social- and engineering sciences – and much more. They have the right to award all types of degrees, like Diplom degrees and PhDs (for example: for engineers Dipl.-Ing., Dr.-Ing.).
- “Fachhochschulen” - Universities of Applied Sciences: These grew out of engineering schools (some existed for more than 100 years) and reached their current status of Fachhochschulen in the early 1970s, and offer today courses in engineering, computer science, business administration and lots more. Their focus is on professional education to teach the skills and knowledge (which is practice combined with theory) graduates need to succeed in their jobs. A part of the education is practice

in industry. Fachhochschulen have the right to award degrees like the Fachhochschul-Diplom (for example: Dipl.-Ing.(FH) for engineers).

- “Berufsakademien” - Universities of Cooperative Education: This is a new type of education institution, in which the academic part of institutional training is reduced and a large part of the education is shifted to industrial partners. They have the right to graduate their students with degrees like the Berufsakademie-Diplom (for example: Dipl.-Ing.(BA) for engineers).

These types of universities (public universities) are overseen and funded by the state-governments, which are by law required to safeguard academic education. Generally speaking, by law, academic education is free for the students.

In addition to these public universities, we have private universities; the first were established several years ago. They offer various academic programs and students have to pay fees.

The academic programs are organized in semesters (in a few exceptions trimesters). The winter-semester starts 1st of September, the summer-semester starts 1st of March. At the Universities of Applied Sciences, each semester contains of 15 weeks of lectures and 3 weeks for exams.

3. Education of Engineers

Students receive the education needed to successfully perform an engineering job in industry or one as an independent engineer. The education takes up to 8 to 10 semesters.

At Universities of Applied Sciences, for example, the education is usually 8 semesters in length. In Baden-Württemberg, the Diplom-courses are organized in 6 study-semesters at the university and two semesters for practical education in industry. The structure for my university (FH-Furtwangen), is shown in fig.1.

The structure allows for an education of the basics in the first three semesters, which contains mathematics, physics, basic of engineering, computer science, soft skills, languages and so on. The third semester is a semester in the industry with non-engineering, but job-relevant topics, like working in a commercial or production setting. There, students can benefit from the experience of people working in that environment, with whom they may have to work with in the future, in their future job.

Starting with the fourth semester, the education enters the advanced level and includes special topics. The sixth semester is a practical semester too. In this second practical semester, students work in industry, in an engineering

environment, for example as participants in small projects. They can gain insight into an engineer's job and there is the possibility to establish personal ties with companies. The companies themselves have the option to “test” future employees.

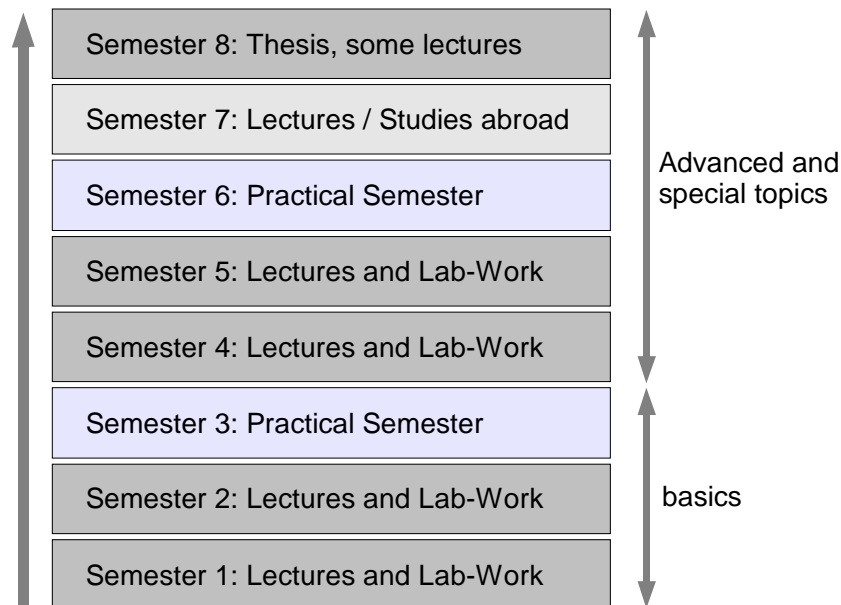


Fig. 1: Education-structure of a Diplom-program at the FH-Furtwangen

In the last semester, a final project of about 4-6 months, the Diplom thesis, is conducted. In this final project, students produce the “master-piece” of their education. It is a project at the university or in industry, supervised by two professors.

In all semesters, theory-based education is supplemented by practical education in laboratories. Our graduates are well accepted by the German industry.

To open the program for studies abroad, the 6th, 7th or 8th semester is designated for spending a semester in a foreign country. In the 6th semester, the stay abroad can be practical work at a university or in industry. The 7th semester could be spent at a partner university. Therefore the content of the lectures should be easily substitutable with courses of the partner university. In the 8th semester, the student can carry out his thesis abroad. All options are used by Diplom students. Spending one semester abroad is an important part of an academic education and should be more emphasized by universities.

At “research” universities, we have similar Diplom programs, but without practical semesters. The duration of studies is – on average – a little bit longer, and the focus is more on scientific- and research aspects. This focus allows graduates to join doctorate-programs.

4. New Structures

The earlier mentioned Bologna Process started affecting education laws in Germany in 1998. The federal framework law on education allows public universities to change the academic degree structure. The framework is as follows:

- New study programs completely installed by 2010
- Tertiary education up to Master's degree of 10 semesters in total length (maximum).
- Degrees: Bachelor and Master's
- Courses must have a modular structure and a credit system
- Focus on quality control by means of evaluation and accreditation instead of the government

In Germany the 5-year-limit (10 semesters) is dealt with in different ways. One model defines a 3 year Bachelor's program (6 semesters) with a 2 year Master's program (4 semesters). Another model defines a 7 semester Bachelor and a three semester Master. At the University of Applied Sciences Furtwangen we decided to use the second model because this way we can provide 6 semesters of study at the university. This is required by accreditation agencies, and we have one semester as a practical semester, which is crucial to the mission of a University of Applied Sciences (fig.2). We got a 6+1 model.

At first glance, it looks like the structure shown in fig.1, except for the first practical semester. But this is not true. The semesters are reduced in contact hours for lectures and lab work. Students have to do more at home. For example: A Diplom program encompasses an average of 160 – 175 lecture hours (including lab-work), a Bachelor's program is 140-160 hours in length. The new structure will become clearer if we take a look at the details:

- The extent of lectures and lab work is defined by the workload of the students. Base for the calculation is a credit system (ECTS=European Credit Transfer System). One semester of full-time study is made up of 30 ECTS points total. All lectures, labs, seminars etc. attended in one semester have a value of 30 ECTS points.
- The class structure is modular in nature. ECTS points are assigned to the individual modules. Modules are transferable between different departments or universities.

- At the FH-Furtwangen, we decided to create a strong modular structure. There are 5 modules in one semester. One module contains 6 ECTS points. The advantage of this structure is that transfer and exchange of modules is easily possible within one program and with other programs. The disadvantage is that the relative weight of certain classes may be unintentionally raised or lowered, since every module will be assigned the same number of credits.
- A detailed description of the content and learning objectives is required for each module.
- The fifth semester is a practical semester similar to one in the Diplom program and counts for 30 ECTS credits.

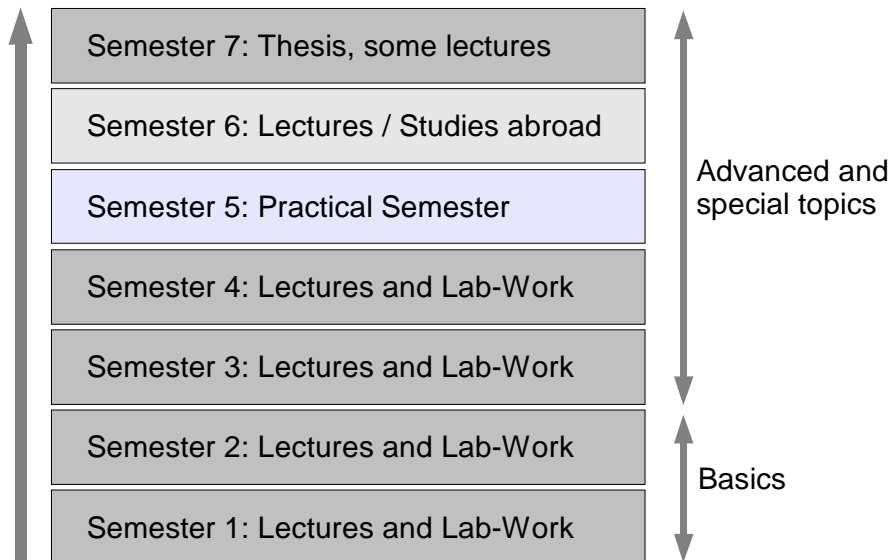


Fig. 2: Education-structure of a Bachelor's program at the Fachhochschule Furtwangen

For the (consecutive) Master's programs we have 3 semesters left, having to adhere to the frame of 10 semesters ((6+1)+3 model). The Master's program brings a student's education up to a professional scientific level. You see the structure in fig. 3. An important part is the thesis at the end. This final project is research based, carried out at university or in industry. To run a successful Master's program, it is necessary for a university to possess a supporting research structure.

To foster mobility, which is important in a growing European Union, universities have to offer programs which are fully or in part suitable for international

exchange. This requires a certain number of classes taught in the common international language. In the case of engineering education, the common international language is English. Especially in countries like Germany (or Hungary), the German (Hungarian) language may serve as a barrier, keeping interested students away from the country. Language is not a problem when students spend an entire academic program in a foreign country. But the concept of mobility focuses on shorter periods of study. Therefore it is important to have programs that are fully or partially taught in English. No less important is the integration of foreign students. The means for integration is language as well. Universities need a decent number of language classes (teaching the locally spoken language) to support the integration of foreign students.

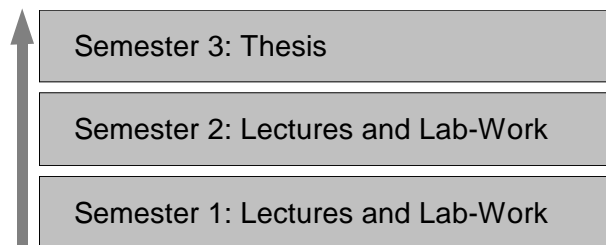


Fig. 3: Education-structure of a Master's program at the FH-Furtwangen

5. Advantages and Risks

The title of this short presentation is “New University Education Structures: Challenge for the Future”.

What is the challenge? In my point of view, the new structures offer a new framework, with the following advantages:

- Compatibility between the States of the European Union and the global world
- Flexibility using the credit transfer system und the modular structure
- International mobility due to the nature of modules and the transfer system
- Standardization of the final degrees
- Faster education for the “normal” job-orientated (Bachelor's) students and an additional stage offering a higher scientific qualification (Master's programs)

- Quality assurance through evaluation and accreditation with common standards

All these advantages will help prepare Europe for the global world. A high quality education is the foundation of the countries of Europe.

The risk is that established and well regarded programs have to be eliminated or reorganized. The acceptance by students and industry has yet to be tested. Because of the political guidelines, universities in Europe have to follow this new way into the future. After the reorganization process, universities will emerge as competitors on the education market, which is new to some countries. The reorganization will cost a high amount of effort and money; it is not for sure that the quality of education will increase in proportion.

Conclusion

The next five to ten years will be a remarkable period in the history of German universities (and other European countries). In the past, there has never been such a dramatic change in the structures of tertiary education as there is today.

In my opinion, the advantages outweigh the earlier mentioned risks. The countries of Europe will have more of a European identity than before, and a strong and common education framework will help prepare the countries for years to come – a challenge for the future.

Links

[1] <http://www.bologna-berlin2003.de/>

[2] <http://www.bologna-bergen2005.no/>