

German-Chinese Cooperative Bachelor in Engineering Physics/Optoelectronics

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ABSTRACT

The University of Shanghai for Science and Technology (USST), the Coburg University of Applied Sciences and Arts (CUASA) and the OTH Regensburg, University of Applied Sciences (OTHR) established an English taught international cooperative bachelor program in the area of Engineering Physics/Optoelectronics. Students from China study their first four semesters at USST. They continue their studies in Germany for the last three semesters, including an internship and a bachelor thesis, graduating with a Chinese and a German bachelor degree. Students from Germany study their third and fourth semester at USST to gain international experience. While the first cohort of Chinese students is currently in Germany, the second cohort of German students is in Shanghai. Up to now the feedback regarding this study program is completely positive, thus it is planned to develop it further.

Keywords: German-Chinese Bachelor Program Engineering Physics Optoelectronics

1. INTRODUCTION

With a strong foundation of scientific courses and practical experience, the Engineering Physics program of Coburg University of Applied Sciences and Arts (CUASA), introduced in a German taught version in 1996, provides skills and experience to develop new technologies and interdisciplinary engineering projects. Apart from basics in natural sciences, the students acquire practice-oriented skills from engineering and applied computer sciences. In this multifaceted study program the students learn how to solve problems scientifically and thus are prepared to meet the needs of future development and advances in technology [1]; therefore it was considered to be an appropriate environment for an English taught transnational bachelor program.

The hosting universities are well-established universities, with experienced professors having a lot of research, practical and international experience in their profiles. University of Shanghai for Science and Technology (USST) and CUASA cooperate in transnational education since 2007 with respect to the master study program “Analytical Instruments, Measurement and Sensor Technology (AIMS)”. Since 2014 the cooperation between both universities has been extended by the foundation of the Sino-German College of USST (SGC), where the OTH Regensburg, University of Applied Sciences (OTHR) obtained membership as well. In 2014 the new international bachelor program Engineering Physics / Optoelectronics started as a joined project of these three member universities of the SGC. In the following the contributions of the cooperating universities, the structure and content of the bachelor program and the experiences collected so far will be described.

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2. COOPERATING UNIVERSITIES

Engineering Physics combines the specialties of all three universities: CUASA as a specialist in sensor technology with its Institute of Sensor and Actuator Technology and USST with the College of Optical, Electrical and Computer Engineering as our partner at that time. OTHR joined this program as the third partner with its clean room facilities, the expertise on microsystems development and the study focus on Optoelectronics Engineering.

2.1 The University of Shanghai for Science and Technology

The University of Shanghai for Science and Technology (USST) has over 100 years of history and is a famous university in China. USST has 18 colleges, 44 institutes and 26 research centers. USST has 24900 full-time enrolled students, including 17700 undergraduate students and 7200 graduated students. The School of Optical-Electrical and Computer Engineering (OECE), which is responsible for the bachelor program Optoelectronic Engineering, is one of the largest and the best schools in USST, it has 5 departments and more than 4000 full time students.

2.2 The Coburg University of Applied Sciences and Arts

The Coburg University of Applied Sciences and Arts (CUASA) is a university with over 5000 students, which is characterized by practice-related teaching and research as well as a strong practical bias. It has grown significantly over the last ten years. The number of students has doubled. The Department of Applied Sciences covers the entire spectrum of natural sciences. Physicists, biologists, chemists, mechanical engineers and mathematicians teach and research here. The department has modern laboratories where students work together with instructors to complete experiments and to conduct research on current application-oriented questions. The program "Engineering Physics" is offered as a study branch in the bachelor program "Technical Physics" and gives the students the opportunity to study in English and to gain international experience.

2.3 The Ostbayerische Technische Hochschule Regensburg

The Ostbayerische Technische Hochschule Regensburg (OTHR) is a German University of Applied Sciences, located in Regensburg, Bavaria. Nearly 11.000 students are enrolled in bachelor and master programs of eight faculties. The focus is on technical topics; 70% of the students study engineering programs. The faculty "General Studies and Microsystems Technology" offers the bachelor program "Microsystems Technology". The default study program is offered completely in Regensburg in German language, whereas students in the study branch "Optoelectronics" do an exchange year at USST in Shanghai and attend English lectures. The faculty has a strong focus on application oriented research with intense industry collaborations and an own clean room facility.

3. FRAMEWORK OF THE COOPERATIVE BACHELOR PROGRAM

3.1 Objectives of the program

This bachelor program aims at endowing students with strong capabilities in mathematics and physics, engineering skills particularly in optical and electronic technologies as well as a professional proficiency in the English language. Besides this, they shall gain an international vision, develop innovative strengths together with the ability to be flexible and adapt to the modern industrial development.

Thanks to this program, graduates are expected to work within the field of international engineering. Suitable working fields would be optoelectronic product design, research & development, product manufacturing, testing and automation control. A general management career can be also pursued due to the graduates' acquired knowledge of international structures and because of their excellent communication skills.

The involved universities strengthen their institutional profile and reach a higher international visibility due to enhanced international partnerships. Universities offer more English courses and therefore attract more international high performing students who also give impulses to their fellow students. These effects further corroborate the international development of the universities.

3.2 Requirements

The students in this bachelor program may originate from the bachelor programs Optoelectronic Engineering of USST, Engineering Physics of CUASA or Microsystems Technology of OTHR. Those who wish to continue their studies at one of the partner universities are required to have a solid foundation of English, mathematics, optic and electronic.

With respect to their language knowledge, applying students are expected to be able to read and understand both industrial and academic texts and to express themselves in English fluently. Chinese students have a proven basic knowledge of the German language, too.

In particular from applicants of USST competences in the following fields are required:

- basic theory of photonics
- laser technology and application
- electronic
- optical design
- optoelectronic detection technology
- optoelectronic communication technology (including analysis and design capabilities with respect to optoelectronic modules and products)
- computer technology

Furthermore, they are expected to be creative as for development and research of new technologies, processes and products. They have to be confident with general project management and business economics topics.

3.3 Characteristics

This program is a joint application-oriented cooperation program between USST in China and CUASA and OTHR in Germany. The partners from China and Germany will grant the bachelor degrees of "Optoelectronic Engineering" and "Technical Physics" separately. Taking advantage of excellent resources of German faculties and modern teaching modes in Germany and the excellence of USST in the combination of optics and electronics, this program will provide superior chances on an international labor market to the graduates.

Lectures and seminars are generally held in English. During the first and second year, Chinese students will focus on strengthening their English knowledge and they will learn German up to a certified standard. As for the second year, German students will join USST, thus attending the English classes together with their Chinese colleagues. This will help both student groups to get to know and understand their cultures. In particular, Chinese students will be prepared and gain important information on their period of study in Germany at the university.

After the second year there will be a selection among the Chinese students: Those students, who satisfy the requirements to study abroad will be able to attend the German university and continue their study under the supervision of local professors for three semesters there. They will attend lectures taught in English and accomplish both an industrial internship and their bachelor thesis in Germany. After collecting all of the required credits they obtain both a degree from USST and CUASA, which is valid both in China and Germany.

4. STRUCTURE OF THE COOPERATIVE BACHELOR PROGRAM

4.1 Recognition of ECTS

Due to the joint planning and development of core curricula, the recognition of ECTS in this joint program is fully secured. For ref. [3,4] for a survey on a Sino-German course in mechatronics engineering and automotive engineering, respectively.

For Chinese students the curriculum normally lasts for four years in accordance to the credit system. In compliance with the education scheme, Chinese students are required to collect all Chinese credits of study according to the module plan before graduation; the credits obtained from the German partner universities within the cooperative bachelor program will be charged on their Chinese account as well. The graduation requirement of the German bachelor degrees will comprise 210 German credits. On the condition that they satisfy all of the requirements listed above, two Bachelor degrees in "Optoelectronic Engineering (SGC)" from USST and "Technical Physics" from CUASA respectively, will be

granted to Chinese students. Chinese students may also select courses from OTH Regensburg in the seventh semester. The course credits are accepted in mutual recognition and replacement among USST, CUASA and the OTHR. German bachelor programs at universities of applied sciences are generally seven semesters in length – six classroom semesters on campus plus a compulsory internship semester in a company or a research institute. German students studying in this international study program from Coburg and Regensburg will go to USST in their third and fourth semester.

4.2 Establishment of the cooperative bachelor program

In order to establish this cooperative bachelor program the curriculum was approved by the relevant authorities of both institutions. On the one hand, the Coburg University established the Engineering Physics study branch as part of the bachelor program “Technical Physics” and introduced English taught lectures from the fifth semester onwards. Minor changes in the modules were made to match it with the USST teaching plan. On the other hand, the Optoelectronic syllabus was updated to match the credit points between the universities easily. Both study programs prepared and obtained successfully the ASIIN accreditation certificate, which assures and strengthens the quality of program.

4.3 Challenges

Challenges of this complex program can be clearly divided into organizational challenges between the partner universities and challenges that students have to face while being abroad. Last mentioned challenges include the integration of students into an existing bachelor program as well as into the university community. The implementation of special modules aims to support the students in that respect.

In an effort to make this transnational educational program sustainable constant agreements between the participating partners are indispensable. Hence the faculties have established a joint management commission, in which the partners discuss and address emerging problems. Difficulties regarding courses and credits recognition are solved in this commission. As indicated earlier the adjustment of the curriculum and the international quality standards of ASIIN facilitate the discussion and adjustment of credit points and workload.

Whereas academic and administrative problems could be solved up to now in bilateral negotiations, some legal and financial differences still remain unsatisfied: In contrast to China, where students have to pay tuition fees, there is no legal basis for incomes from tuition fees for the German partner universities. Therefore, the additional expenses caused by this program have to be covered from the budget for the national programs, which imposes a severe restriction to all the efforts aiming at further improvements of the quality of the program.

Therefore, the program directors are going to apply for extra funding from state and federal institutions for this transnational program. Another challenge is the imbalance between German and Chinese students with respect to the degrees: Whereas successful Chinese students will obtain two degrees, the same is not possible for German students, because they will not be able to fulfill the corresponding legal requirements of a Chinese degree. The German partner universities are going to table this desire for equivalence in the awarding of the degrees in future negotiations with the Chinese authorities.

5. STUDENT STUDY ABROAD CRITERIA

CUASA has determined its own method of selecting students for the study abroad program (regulated in the examination regulations), ascertaining that each participating student is proficient in the language of instruction at the host institution and attesting that all students fulfill the academic and disciplinary requirements specified for the study abroad program.

On a yearly basis CUASA will nominate one or more professors to select the students from USST (in cooperation with OTHR). The interview is also a basis for the visa procedure. Moreover, students have to prove their German knowledge on a level A2 according to CEFR.

The number of students both in China and Germany is limited to 30 individuals per year respectively.

6. SPECIALTIES OF THE PROGRAM IN GERMANY

6.1 Laboratory training courses

The program includes a comprehensive lab training consisting of eight experiments in the field of solid state and atomic physics. Students perform the experiments in teams of two people in a modern lab under the supervision of professors and lab engineers. Each experiment comprises a preparation, an execution and an analysis part. In the preparation phase the students study at home the theory of the subject and the equipment to be used, guided by a provided assignment. The execution is done in approximately 90 minutes and begins with an oral exam to check the preparation of the students. After the discussion of security issues, students start the experiment following the assignment. The immediate results of the experiments are collected in a protocol. This protocol is the starting point of a scientific report containing the extended analysis, error analysis and background information. This report is the outcome of the analysis part of the experiment, which is done again at home.

The lab course is mainly aimed at improving skills like self-study preparation, handling modern lab equipment and scientific reporting. Of course, both experiment and scientific report shall deepen the knowledge gained during lectures through its direct application.

6.2 Internship

Gaining professional experience already during bachelor education is an essential part and a unique feature of the education system of German universities of applied sciences. The obligatory internship of in total 20 weeks has various benefits for the students. Already the application phase is a very useful experience for the students: They learn how to search for open positions, how to write a CV with cover letter and they learn how to perform in job interviews. They are prepared for these challenges within a special lecture. Already the first group was very successful: Almost all of the Chinese students found internship positions, mainly in German High-Tech companies. After the successful application students enter companies and work under the supervision of an engineer within a project, approved by the supervising professor. In the end of the internship the students compile the results of the performed research in an internship report. The obligatory internship in industry has various advantages for the company and the student. For example, the company can benefit from the state of the art education and the workforce of a new motivated team member. Furthermore, the connection to the university allows for possible follow-up projects with the academic partner. The student, on the other side, has the possibility to learn in leading-edge industry projects – especially practical project management and German work culture. The most important advantage for both sides is the mutual evaluation of a potential future employer and employee, respectively.

6.3 Bachelor Modules

The curricula of the participating universities were adopted to guarantee easy student exchange and credit transfer.

The modules for students in the first year of the bachelor program are as follows:

Coburg University of Applied Sciences and Arts (Semester 1&2; in German)	USST (Semester 1&2)
Physics 1 (optics) Construction and CAD Physics 2 (mechanics) Mathematics 1 Mathematics 2 Applied electricity/electronics English Scientific working method Chemistry	Physics (optics) AutoCAD Physics (mechanics) Mathematics I Mathematics II C programming English Selective Course (general) Chemistry Semiconductor Materials Circuit principles

During the second year, German and Chinese students participate in the following modules:

University of Shanghai for Science and Technology (Semester 3 & 4)
Analog Circuits MATLAB Probability Theory and Mathematical Statistics Packaging VC Programming /Software Design Electromagnetics Digital Circuits Signals and Systems Thermodynamics Solid State Physics I Physical Optics Principles of Single Chip Microcomputer and project of Single-Chip Microcomputer Language (German for Chinese students, Chinese for German students)

After studying one year together at USST, Chinese and German students continue the bachelor program at CUASA in the English taught study branch “Engineering Physics”.

Coburg University of Applied Sciences and Arts (Semester 5 to 7)
Mathematical Methods for Physicists Computer Based Measurement Technology Physics 5 (Advanced Solid State) Materials Science Physics 6 (Atomic and Nuclear Physics) Practice related module Language (German for Chinese students) Electives: e.g. Scientific Reporting and Documentation, Computer Simulation in Physics Interdisciplinary student project Bachelor thesis and bachelor seminar

Alternatively students may continue their seventh semester at OTHR with a stronger focus on optoelectronics.

Ostbayerische Technische Hochschule Regensburg (Semester 7)
Optoelectronics Fiber Optics Photonics and Laser Technology Bachelor Thesis

6.4 Intercultural skills

Engineering physics will not only provide its students with qualifications in the field of engineering but also with intercultural competences and language skills. In order to work successfully in international operating companies the students participate in English and Chinese classes. Moreover, they will get practical experiences in laboratory courses. An internship and a bachelor thesis will bring them to the core of industrial research and development. The students also have the opportunity to experience the culture of living and working in the country of the partner institution, as well as the opportunity to have contact with the enterprises and research institutions.

Especially in the engineering branch with its growing internationalization and global working companies, intercultural competent graduates are needed. Although the program is already designed in a way that students get in touch with students from other nationalities and cultures and even go abroad for one year, this does not automatically lead to intercultural competences. Considering the definition of intercultural competences as “effective and appropriate behavior and communication in intercultural communication” [2] additional efforts seem to be appropriate. Therefore, supplementary courses are included in the curriculum to raise intercultural awareness and sensitivity. An intercultural training addresses differences in communication between Germany and China as well as different learning traditions. To benefit from the intercultural group of students a student peer program promotes cultural exchange.

Considering the internship that students have to complete in their sixth semester, they should be provided with specific knowledge in that area. Internship training imparts knowledge about personalized applications and successful job interviews.

7. EVALUATION

In order to improve the study conditions, the Coburg University evaluates this Sino-German program in Engineering Physics/Optoelectronics, especially with regard to the professional expertise, practical experience and individual/personal gain of this program.

The Engineering Physics team created with the aid of the survey software “Questor Pro” [5] an online survey and the first cohort of Chinese students, which is currently in Germany for their internship semester, was asked for their opinions about this new program.

With this small quantity of answers no statistical evaluation is possible but it is important to see a first tendency.

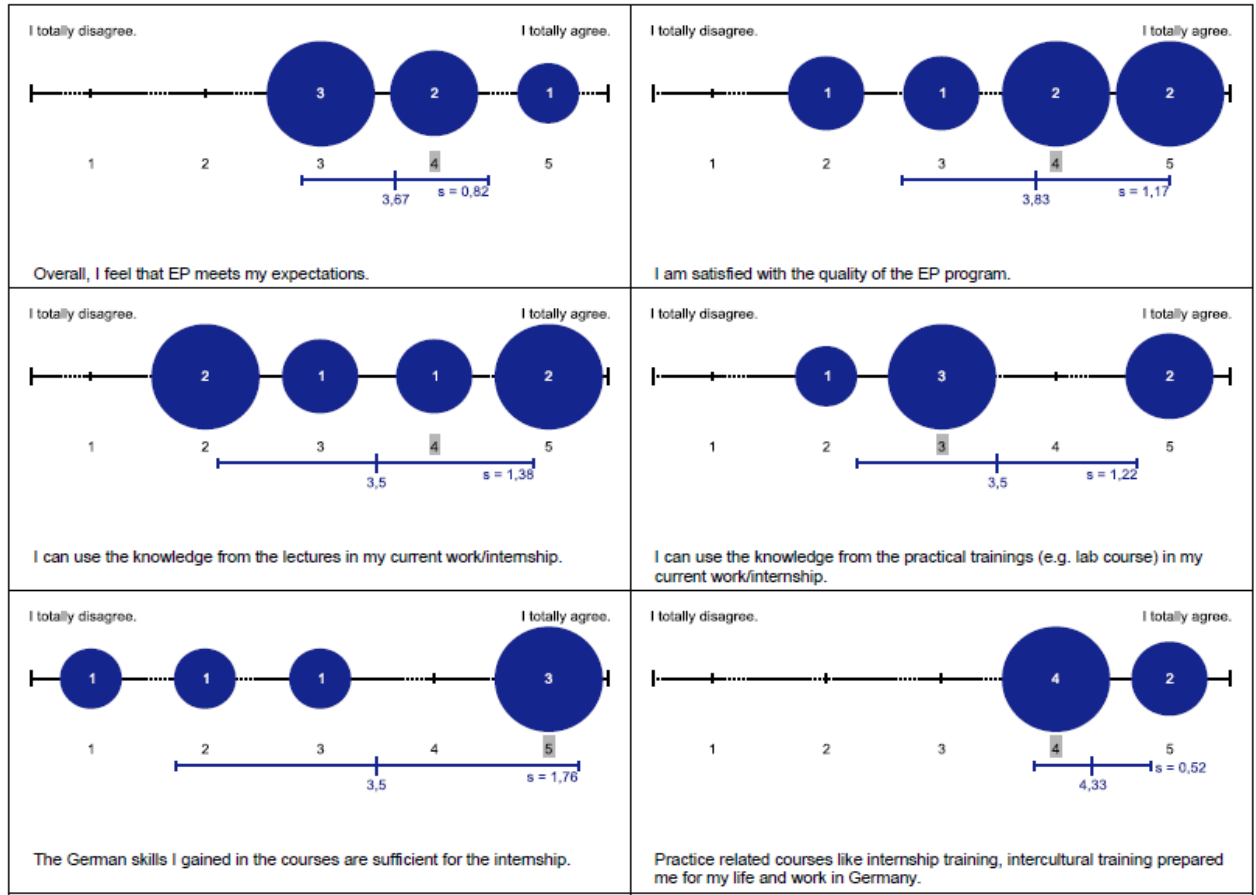


Figure 1. Professional Preparation for Internship

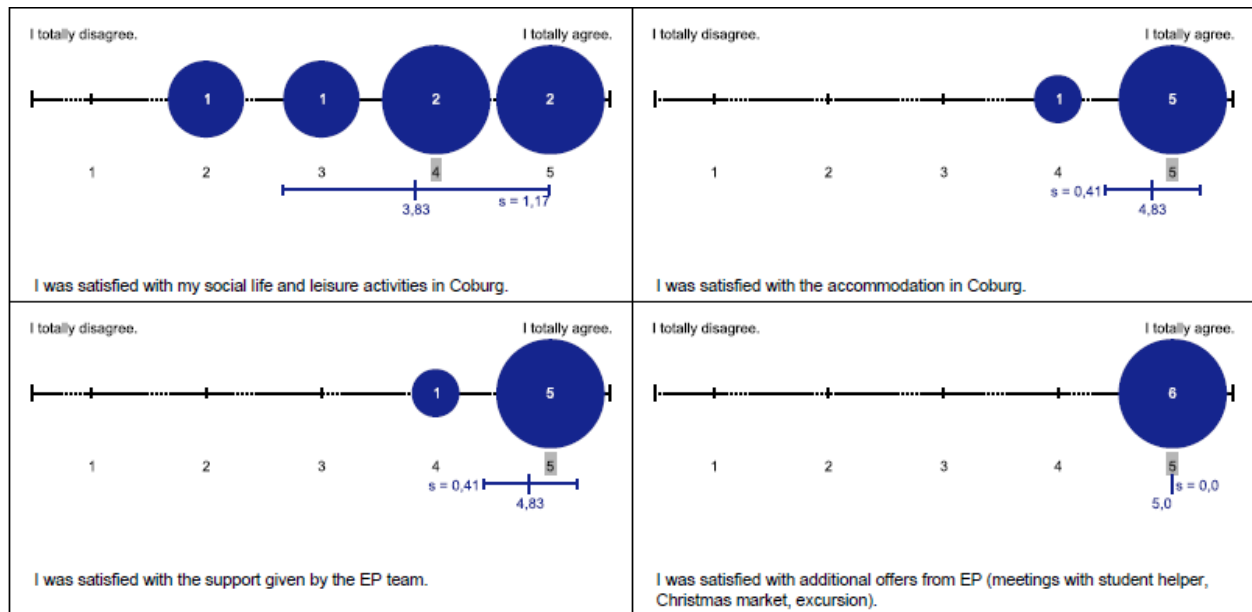


Figure 2. Social Support in Coburg:

Fig. 1 shows the students' satisfaction with the program and the academic preparation for the internship. Overall, the quality of the program is evaluated as high and students feel well prepared for the internship. They especially appreciate the off-topic preparation including an internship and intercultural training, which are specialties of this program. Possibilities for improvement should be investigated further by detailed discussions.

In Fig. 2 the students' satisfaction with accommodation and social program in Coburg was overall very high. In particular, the support given by the team of Coburg University is considered as very high. No real necessities for improvements in that respect can be seen.

Since we pursue the goal of constantly improving the program and aim to ensure the best quality of education for our students the results of the survey have an impact on the future strategic and organizational development of the program. Moreover, it provides an insight on the job possibilities of our graduates when continuing this study after graduation.

8. CONCLUSION

Engineering physicist can be found everywhere, where physical phenomena can be implemented into innovative techniques. Because of the broad scientific education, Engineering Physics allows the graduates to work on technological innovations in the areas of industrial research and development; the combination with optoelectronic skills is a valuable additional asset. Areas might include autonomous driving, biophysics, renewable energy and medical physics. Moreover, our graduates may work in environmental measuring technologies and aerospace.

Our bachelor graduates can work in internationally operating companies in China, Germany or other countries. Students may continue their studies with a master degree in a variety of scientific and technical areas.

9. ACKNOWLEDGMENTS

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