

## **Global Engineering Skills – Practice and Perspective of Joint Educational Programmes in Engineering between a German and Malaysian universities**

### **Hunger, A.<sup>1</sup>**

Representative for International Study Affairs,  
Faculty of Engineering, University of Duisburg-Essen,  
Duisburg, Germany

### **Werner, S.**

Faculty of Engineering, University of Duisburg-Essen,  
Duisburg, Germany

### **Marzuki, M.**

Dean, Faculty of Engineering and Built Environment,  
Universiti Kebangsaan Malaysia,  
Bangi, Malaysia

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## **INTRODUCTION**

Universiti Kebangsaan Malaysia (UKM, The National University of Malaysia) and University Duisburg-Essen (UDE) in Germany co-operate since 2000. Major results are double degree (Bachelor and PhD) and exchange programmes (all levels). Both partners collaborate on 'eye level', agree on outcomes of degree courses and carefully check for equivalences in their curricula. Student mobility shows more than 100 persons in each direction.

Partnership has been institutionalised by the UKM-Mercator Office, an outpost of UDE at UKM, established in 2002, and UKM International Office at UDE, established in 2010, acting as bridge head at the partner.

With this paper, results from about 10 years of experience are presented. Results are promising and give good hints for other programs to adapt.

Recently, partners are fine-tuning their programmes to prepare graduates for the global labour market, beyond pure technical contents, which is standardised around the world. Credits are offered for non-technical courses with intensive experience regarding foreign culture and behaviour as key for global engineering competence.

Partners shared many best practices and learned the work culture which is crucial to sustain long term collaboration. Next step will be to integrate further partners in Southeast Asia, creating a network including south-south mobility to share work load and give the network more strength and visibility. In this context, curricula will be enhanced by new courses integrating technical subjects and cultural experience (e.g. by capstone projects) to give good grounds for the "Global Engineering Skills" offered.

## **1 DEVELOPMENT OF PARTNERSHIP BETWEEN UKM - UDE**

### **1.1 History**

The beginning of the development of internationally oriented engineering education was in 1998, when Germany federal government recognized that the number of international students was going down dramatically. What the authors report today is an engineering education heading to train engineering students to have global engineering skills – and they can show good results regarding this goal. The development started in the Faculty of Engineering of the University of Duisburg-Essen (UDE), firstly as an initiative to attract overseas students to Duisburg, Germany. At UDE, the study program ISE "International Studies in Engineering", was established for this purpose, and at time being, at UDE are ~ 9,000 students enrolled, ~ 1,600 in ISE.

But soon, international co-operations began, and the here described joint study offers and strategic projects were anchored between the faculty at UDE and the Faculty of Engineering and Built Environ-

ment of the National University of Malaysia (Universiti Kebangsaan Malaysia, UKM), both public universities. Both faculties have similar structure and goals, which gave best basis for the development of joint educational programs.

History is mentioned here in details as without this history, described results would have never been achieved. So, the way to the "Global Engineering Skill" is a good deal of these skills itself.

The following stages can be distinguished in this:

- 1998 - 2006: Development of international study courses at UDE
- 2001- today: Development of Double Degree study courses between UDE and partners in Southeast Asia
- 2001- 2006: Institutionalization through establishment of Mercator offices in Southeast Asia in support of partnerships and joint teaching
- 2005: Submission of an application to the DAAD to establish a joint venture with the UKM on the common, privately organized educational institution in Malaysia (GMIA – German Malaysian International Academy)
- 2007 – today: Further management of the Mercator offices from own funds
- 2010 – today: Double Degree Promotion with partners in Southeast Asia (IPID, DAAD)

## 1.2 Educational offers established

The educational offers developed, from pure locally offered degree courses to an interrelated stack of degree courses with different links between the partners. Over the years, an organic growth was observed at first vertically bottom up, from Bachelor till PhD, secondly in between cross-linking on several levels. ISE was the structural basis as English was the common language of cooperation, but the structures developed became more and more independent from any special degree course. Resulting degree courses were:

- **At UDE: International Studies in Engineering (ISE)**
  - 6 Bachelor- and 8 Master´s degree courses offered
  - approx. 1.600 registered students
  - curricular basis for Double Degree- and exchange programmes
  - preparatory foundation for the PhD
- **Double Degrees between UDE and partners in Southeast Asia:**
  - 6 Bachelor Double Degree programmes are jointly conducted with UKM since 2002
  - Bachelor- und Master´s degree courses are currently developed jointly with UI
  - Double Degree programme PromISE, operated jointly with UKM

## 1.3 Institutional integration at the partner universities

In 2002, in the high phase of developing the new educational offers, the private foundation Mercator Stiftung GmbH, Essen supported the joint development of both universities with a reasonable with substantial financial support allowing to set-up an institutionalisation of the co-operation: The Mercator Office was established in 2001 at UKM. Due to success, in 2012 the UKM Mercator Office was transformed into an independent, private company in Malaysia: "Mercator Science & Education Sdn. Bhd., with the aim of funding the joint study programs.

This office gives extensive consulting and support to mobile students and professors. The Mercator offices support the partnerships also by supporting the initiation of joint research projects, organizing events, participation in education fairs, generally the recruitment of students, and are generally known as "German Center" in Malaysia and Indonesia.

In 2008 the dean at UDE established the service facility SCIES (Support Center for International Engineering Students), due to the great importance of the high number of foreign students at the faculty. Goal was to invest money as close as possible to the students – in the faculty, integrate with studies.

Both offices now are able to interact down to offer accommodation assistance through to the contract. When the students board the plane (in both directions) they have a signed rental contract:

- At UDE: SCIES, the service center of Faculty of Engineering provides, housing, partly at the student union, and partly on the private housing market.

- At UKM: The Mercator Office also provides housing on the campus of UKM or in the private housing market. Here in particular, apartments and houses for residential communities come in question.

As further support, since 2010, exists at UDE the "UKM International Office @ UDE", a sister office of UKM, now located at UDE. Background is that students from Southeast Asia are often quite shy according to the experience of German professors, and seek counseling only when it is in the matter "too late". Therefore, a contact point has been established to give these students a "home feeling".

## 2 STATISTICS AND INTERPRETATION

### 2.1 Results regarding Double Degree Program

Over the years of operation of the double degree, the number of participating students showed some ups and downs, as Fig. 1 shows. Reasons were learning steps the partner universities had to undergo.

One of these is mentioned here. The standard scheme of the double degree is "3 +1" meaning the first 3 years of studies are done at home university (UKM), thereafter the final year at UDE. The program started with the idea to deliver as much as "German impressions" as possible, including industrial internship in Germany. For that reason, the "final year" was extended to 18 months. But partners learned that the good idea was hard to implement, either it was hard to find sufficient places for internships just in time, or the both students and companies did like it and the presumed time was prolonged. Both effects resulted in too long study periods, making the program more expensive for the Malaysian students and less attractive due the several problems to solve.

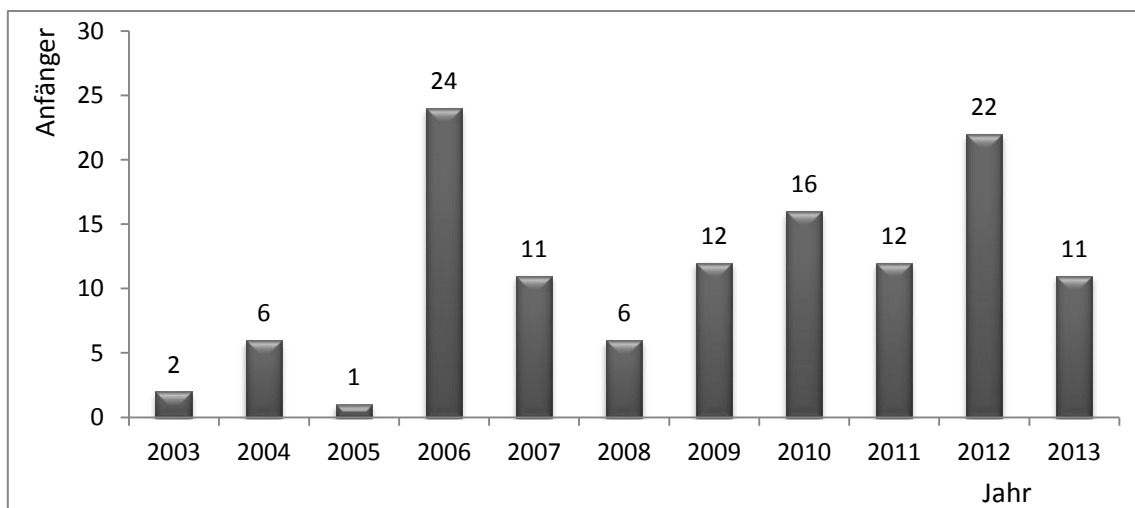


Fig. 1: Number of UKM double degree students at UDE over the years

After understanding this effect, the last year was reduced to 12 months, without an industrial internship, restricting studies to the academic contents. Students now did perfectly adapt to the new scheme, resulting into slowly but steadily decrease average study durations, now being close to 12 months as scheduled as shown in Fig. 2.

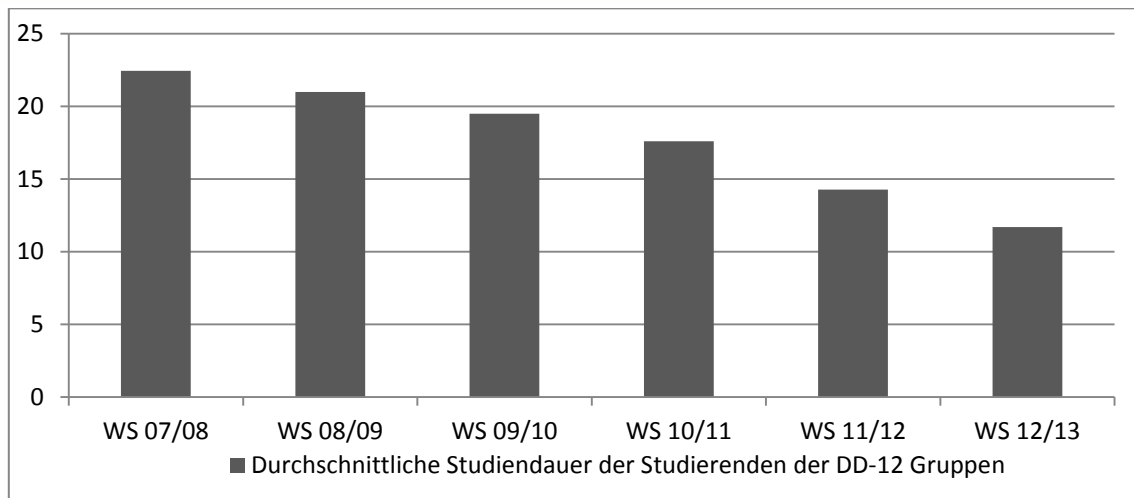


Fig. 2: Average study of final year of the 12-month scheme at UDE over the years

And best message beyond study duration: Out of the 111 double degree students who have passed the program, all of them passed, drop-out rate equal to zero.

Academic achievements of the students always was good, not really affected by the duration and the change of the structure. Distribution of marks in exams (refer to Fig. 3) shows an average around 2.0 in German scale with 1.0 being best and 4.0 pass mark. This result is based on the fact that students have been selected, first, when entering studies, as UKM as one of the best universities in Malaysia can take freshman from the top of the national entrance test. In addition, for going to Germany for the last year, UKM students have to show an average mark of 3.0 out of 4.0 - a challenge to the students.

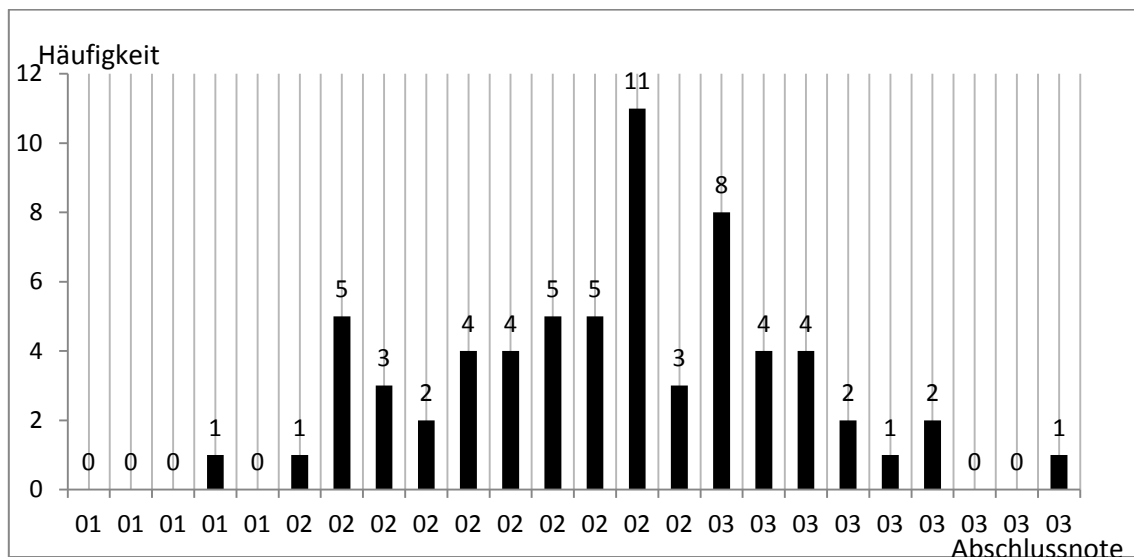


Fig. 3: Average of marks achieved by UKM students at UDE

Out of the 80 students who could be traced after graduation, majority of 62 went for a job in industry. The other 18 students did continue with a Master degree program, 13 of them at UDE. When choosing their workplace majority opted for Malaysia or neighboring countries. 8% did go for a job in Germany, 7% for a German company being active abroad. These figures are positive from the point of view of the partner universities as they show a good mix of academic and job orientation, also acceptance of workplaces in home region or Germany showed a reasonable degree of acceptance of Germany as the "strange" country.

## 2.2 Results regarding Exchange Program

The development of number of students of the exchange program shows a different development over time, as shown in Fig. 4.

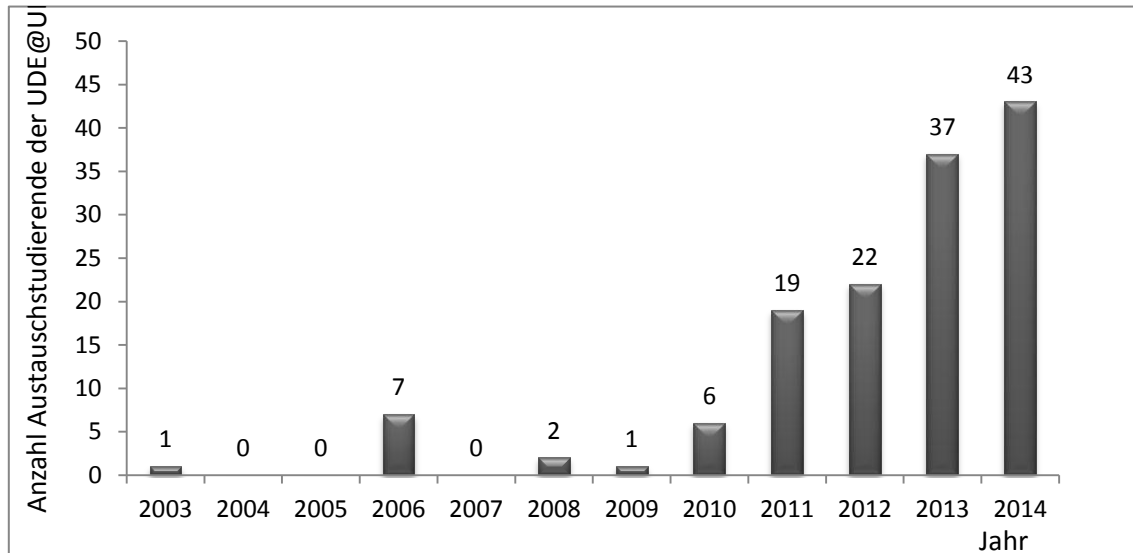


Fig. 4: Number of exchange students from UDE to UKM over the years

The steep increase during last years is considered as result of better support und experience, especially a broader spectrum of available equivalent course as well as the personal service, increased in quality by experience. With Fig. 5, a similar result is given: over long time, the exchange program was mainly attractive for Bachelor students, being young and adventurous; only in last years, under more stable conditions, more master students take the challenge of a semester abroad which can have more (positive and negative) influence on their academic achievements in the relatively short study period of the Master degree.

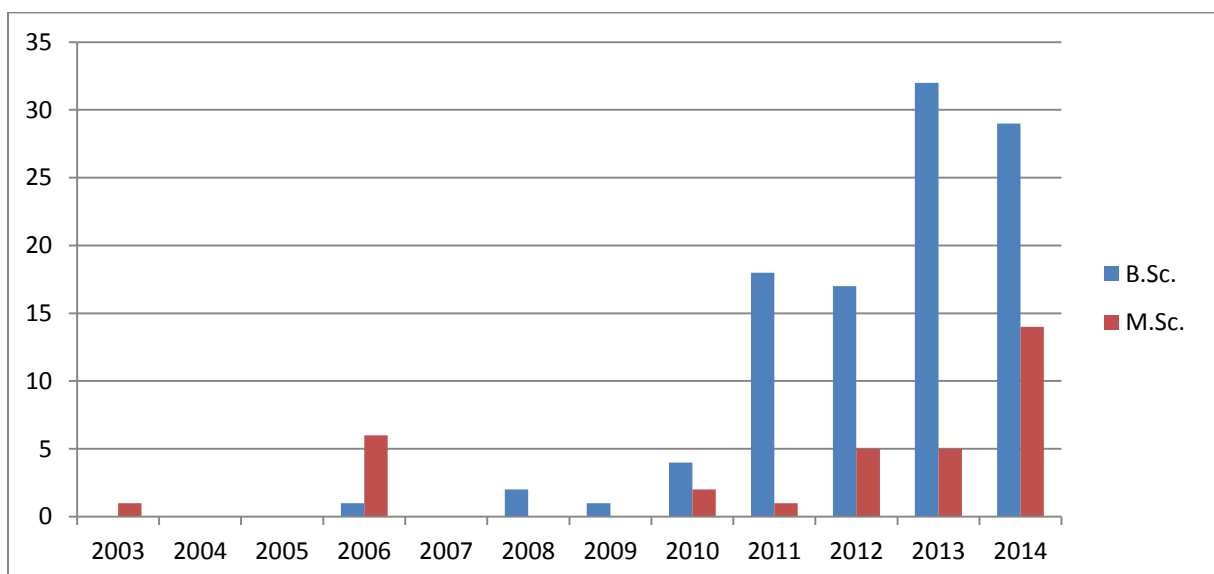


Fig. 5: Number of exchange students from UDE to UKM over the years sorted by B.Sc. and M.Sc.

Another effect fueling the exchange programs is the fact that their attractiveness grows with the development of the double degree courses. The better the double degree program develops with more equivalent degree courses and subjects, the more choice are presented to the exchange students to chose from, like from a menu with many varieties. This fact was underlined by the student population:

Although the program had been developed for the study program ISE, more students joined from different degree courses, feeling that they also could benefit from the exchange, without having it as mandatory part of their degree courses. These participants are coming from regular degree courses like:

- Electrical and Electronics Engineering (EEE)
- Computer Science and Communications Engineering (CSCE)
- Mechanical Engineering (ME)
- Civil Engineering (Civ. Eng.)

Although exchange programs normally are very liberal – whoever wants to go, can – the partners introduced a selection scheme; this became necessary due to the fact that simply too many students wanted to participate. In addition, the partners wanted to keep the quality of the program high as an argument to attract good students with options for further studies, up to PhD.

It is not easy to anticipate chances of a German student in the middle of his study phase as the German study system is very liberal and flexible. In order not to punish the slow but good students, or on the other hand the fast student with mediocre results, a formula was developed balancing between speed of studies, measured in accumulated number of credits and average mark achieved by that time. Students are selected who are either better than average either in speed or mark are as well as those with medium results in speed and marks.

Result was as hopes have been: As Fig. 6 shows, results spread between excellent and good with mean value around very good. This effect is not only positive for the organizers, it will also fuel the program and attract more, and as filtered, better students

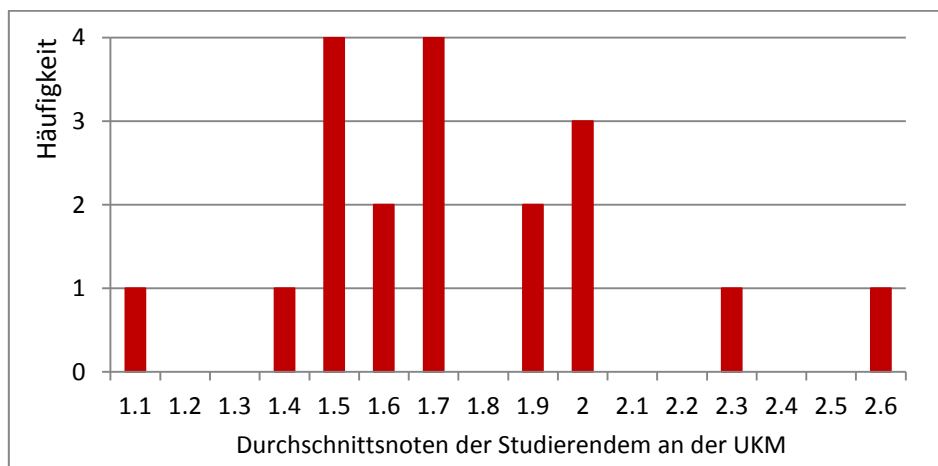


Fig. 6: Average of marks achieved by UDE students at UKME

## 2.3 Interpretation

In general, results are positive for the partners, the programs are attractive, bright students are attracted and best students can be supported for next phases in their academic development.

But: Is that “Global Engineering Skills” at all?

We say yes, as good students are selected to study and survive in an environment very different from home. Solving such kind of cultural problem is able to work in a global environment. And the marks and study result add that these students were able to follow engineering education at a research university of different cultural and historically grown structures – and again, they not only survive, they perform better than the student they meet, in their home environment. Engineering knowledge and skills are standardised, all around the world, but to detect its backbone in a very unusual environment is a really worth to mention skill.

### **3 PLANS TO DEFINE “GLOBAL ENGINEERING SKILL”**

Question now is how to formulate this skill, the “global engineering skill”. Partner universities have agreed to coin it and declare it in the diploma supplements of their degree certificates. And in order to receive this label, needs to participate either in the double degree or the exchange program. In addition, some non-technical courses shall be credited to prove deeper knowledge of the host culture.

### **4 OUTLOOK**

In this paper, it is shown how intercultural encounters and strictly organised academic programs can offer experiences which can be named “global engineering skills”. Also results could be given demonstrating that engineering skills can be combined with cultural experience, without watering down what is understood as good engineering study results.

Partners UKM and UDE are open to share their ideas and results with other interested parties, as something broad as “global engineering skills” needs refinement and development by way of academic discussions and further applications. A community to develop this label further would be the best what could happen.

## 5 REFERENCES

Material presented here is unpublished before. But the mentioned programs and findings have been published on various conferences. Some of the resulting papers are listed below.

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