

PISH COUNTRY STUDIES

(Germany)

PISH PROJECT



Erasmus+

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Section 1: Introduction

Table 1: Profile of respondents to the country report.

Profile of the respondents	
• Number of teachers who filled in the survey	6
• Number of students who filled in the survey	6 (3 foreign students, 3 local students)
• Names of HEI represented in the Interview	The Hasso Plattner Institute, The Technical University of Berlin, RWTH Aachen University, University of Kassel
• Countries of origin of foreign teacher(s) interviewed (if the teacher is a foreigner).	France, Iran, Turkey
• STEM courses taught by the teachers interviewed	Metal forming process, Electrical Engineering in Agriculture, Data Science
• Country of origin of students interviewed	Germany, Spain, Brazil
• STEM discipline or field of study of the student	Data Engineering, Media Informatics, Computer Science, Physics Engineering, Transport Engineering
• Gender of teachers interviewed	n/a
• Gender of students interviewed	n/a

Note on methodology.

The German case study was carried out using a mixed methodological framework. Due to COVID-19 lockdown restrictions, it was more complicated to organise live meetings. Therefore some interviews were carried out online, using video communication software. Some students and teachers have filled in a questionnaire that was based on the research questions designed for the purpose of this report.



Section 2: State of the art on HEI STEM in Germany

Section 2.1: Profile of STEM students in Germany

Table 2: Profile of HEI STEM students in Germany

Indicators	
• Number of HEIs in the country.	423 HEIs in 2020/2021.
• Number of STEM students in each HEI.	In 2019/2020, there were 1,096,773 STEM students in total.
• Average number of students per class.	Not available
• Average age range of STEM students (Optional)	n/a
• Average number of foreign students in total	411,601 in 2019/2021, 416,315 in 2020/2021
• Resident foreign students	91,699 in 2019/2020
• Percentage of students from EU and non-EU countries	Not available

The German higher education system has not only grown over the past decades, it has also diversified. The most important change was the introduction of the Universities of Applied Sciences (*Fachhochschulen*) alongside the traditional research universities in the late 1960s. According to Destatis, in 2020/2021, in total, there are 423 university-level institutions, in addition to a number of HEIs that are not classified as tertiary institutions such as *Berufsakademien*, sometimes referred to as Universities of Cooperative Education. The latter are more vocationally oriented institutions than Hochschulen. (Universities, Colleges of education, Colleges of theology, Colleges of art and music, Specialized colleges of higher education (211 STEM institutions), Colleges of public administration).

In 2019/2020, there were 1,096,773 STEM students in total, 31% were women. The three most studied fields are "*Engineering sciences*" (774,687 students, of which 24% are women), then "*Mathematics, natural sciences*" (with 322,086 students, of which 49% are women), and finally "*Computer science*" (237,530 students, of which 22% are women).

Based on provisional results, the Federal Statistical Office (Destatis) also reports¹ that the number of foreign first semester HEI students declined by 21% to 99,400 compared with the previous year. 10,934 of the new international students enrolled in STEM, or 11%.

¹ https://www.destatis.de/EN/Press/2021/03/PE21_133_213.html



In the winter semester 2017/18, the five most important countries of origin of international students were China, India, Russia, Syria and Turkey. Roughly 29% of all mobile foreign students (Bildungsausländer) came from these top five countries of origin in the winter semester 2017/18. Almost 52% of the international students have chosen a STEM subject. A look at the top five nationalities of international students shows that the share of STEM subjects is highest among Indian students, at roughly 77%.

Section 2.2: State of the art on STEM education in Germany

National attitude/policies and initiatives towards promoting STEM education in Germany.

In 2019 German Chancellor Angela Merkel has expressed concern about the technological competitiveness of Germany and Europe². As a result, calls for more students in STEM (science, technology, engineering and mathematics) disciplines have become louder. In fact, the proportion of STEM students in Germany has increased significantly since the turn of the millennium, and the percentage of STEM graduates is relatively high by international standards³.

Data from the German Federal Statistical Office from 1975 to 2017 show that in the winter term 2015/2016 the percentage of STEM students reached 40.5% and has remained constant since then. Once again, STEM subjects have become the most popular subject group among the 878,000 new university students; 351,000 students were taught in STEM subjects.

According to a 2015 paper, the number of STEM graduates positively influences the number of patents per resident, while non-STEM graduates do not influence regions and countries in this way. The OECD provides data on the percentage of STEM graduates from all member states. Germany tops this statistic. In 2016, 36% of German graduates were STEM graduates; in France, the percentage was only 26%. According to the OECD, in 2017, 31.3% of all 25-34 year olds in Germany had graduated from a university, polytechnic or similar form of higher education. The OECD average is much higher (44.5%). In short, Germany has relatively many STEM students, but relatively few students in general. Nevertheless, having a low percentage of students is not as bad as it seems, because of the opportunities for on-the-job training outside higher education that are common in German-speaking countries. In other words, Germany's dual education system has proven to be effective in equipping young people with the necessary skills to perform in competitive labour markets without having to study at university level.

² <https://www.nrz.de/video/merkel-fordert-neuen-eu-rahmen-fuer-technologische-aufholjagd-id216796619.html>

³ <https://en.irefeurope.org/Publications/Online-Articles/article/STEM-Popularity-in-Germany-A-Reason-for-Optimism>



University initiatives towards promoting STEM education in Germany

In Germany, STEM is also known as MINT [Mathematik, Informatik, Naturwissenschaft und Technik]. According to the OECD⁴ 2017, 40% of first-year university students in Germany who study subjects categorized as tertiary or service industries choose a STEM field. This is significantly higher than the OECD average of 27%, 31% in Korea, 29% in the UK and 21% in Japan.

A country’s economic development, employment opportunities and education have always been mutually reinforcing. In addition to its well-developed industrial and manufacturing sectors, Germany is a hub of innovation, with German companies from a wide range of sectors operating at the forefront of technology, resulting in a growing demand for innovative technologies and techniques. In recent years, the country has been vigorously promoting Industry 4.0 and the development of green energy in order to remain competitive in the international market, which has led to a surge in job opportunities. This has had a positive impact on the education sector, creating demand for specific programs, particularly STEM education. Of the thousands of degree programmes offered by German universities in the fields of natural sciences and mathematics, hundreds are taught in English, making them a great opportunity for international students.

In all areas of society, there is a broad consensus that STEM education is a fundamental part of creating professional and personal opportunities, taking part in a society, and developing the economy. With this in mind, Germany has significantly increased its efforts in pursuit of high-quality, integrated STEM education. In central alliances, such as Nationales MINT Forum (National STEM Forum, Germany), a number of stakeholders are working toward better STEM education in Germany. These efforts are geared toward concrete areas of improvement, such as qualification for educators and subject specialists, increasing the presence of women in STEM professions, or improving the quality and effectiveness of STEM projects.

Table 3: Overview of class setting for HEI STEM students in Germany

General Respondent Indicators	
<ul style="list-style-type: none"> Average number of students in the respondent students’ classes. 	10-25 (50% of students study in just German groups)

⁴ <https://educate-in-germany.com/blog/2020/10/07/demolishing-the-success-of-stem-in-german-education/>

<ul style="list-style-type: none"> • The profile of groups taught by the teacher respondents 	<p>Interviewed teachers defined various group profiles - number of students 10-25; 20% female to 80% male or more or less balanced; MSc students; 25% foreign students on average</p>
<ul style="list-style-type: none"> • Teaching methods used by teachers (in the order of popularity) 	<ol style="list-style-type: none"> 1. lectures 2. class discussions 3. a combinations of group work and assignments 4. presentations 5. study visits
<ul style="list-style-type: none"> • Teaching methods preferred as reported by students (in the order of popularity) 	<ol style="list-style-type: none"> 1. lectures 2. group work 3. individual assignments 4. presentations 5. class discussions 6. film screening
<ul style="list-style-type: none"> • Mode of student interaction within the class 	<p>Online tools - online calls, chat, email; Discussions; meting in small groups</p> <p><i>Note: these interviews were organised during COVID-19 pandemic, when education was mostly remote/online</i></p>
<ul style="list-style-type: none"> • Language of instruction 	<p>English and German;</p>



Section 3: Intercultural Communication Challenges faced by STEM students

Section 3.1 Intercultural challenges encountered by Students within the classroom

1. Intercultural communication challenges as experienced by students (both foreign and local) in the classroom

a. Language barrier

Both local and foreign students in Germany reported language as being a barrier in some cases. All interviewed students have had experience studying abroad.

b. Intercultural challenges

Intercultural challenges were reported by some students. These challenges are usually overcome by spending more time together outside of the study process. However, it does not always happen, as it hinders students from further interactions.

c. Miscommunication with foreign students

Miscommunication with foreign students is related to both language and cultural differences. Misunderstood phrasing or expressions, little things lost in translation are a few examples that students gave in this case.

d. Differences in working and studying habits

Students coming from different countries and even continents, bring different experiences and backgrounds that are obvious in different working and studying habits. Examples interviewed students gave - the attitude towards deadlines, collaborative vs individual approach to group work

e. Miscommunication with teaching staff

Sometimes foreign students or German students taught by foreign teachers experience miscommunication with staff. It is usually related to language barriers or inability to fully understand what is expected from the task or course materials.

2. Challenges as observed by the teachers in the classroom -

a. Language barrier



Interviewed teachers, both German speaking and foreigners, have reported the language barrier as being a minor issue. Sometimes specific terms have to be clarified, or materials in English explained in detail. Foreign students studying in Germany might need support or more time to understand the instructions given in German. Foreign staff teaching in Germany, also reported German HEI system as not being focused on foreign students. That is a big issue as it, from their perspective, makes Germany a less desirable study destination.

b. Inability to understand what is expected from various assignments

Some teachers mentioned that foreign students misunderstand tasks and assignments, and it becomes clear at the end of the semester, during examinations, because students don't communicate it on time.

Section 3.2: Intercultural communication challenges encountered outside the classroom

Whether the intercultural communication challenges occur outside of the classroom, depends on the activities that students get involved in. From this case study, the majority of respondents said that local and international students usually don't mix in their contexts. One student mentioned a cultural difference, that was rather unexpected:

"I find most of the students here so stressed and pressured, that it seems like they do not even want to make friends. In my country (Brasil) university is a place of happiness and it surprised me that it is not the same here"

Some students mentioned that they have international friends, but usually they are not their fellow students.

The interviewed teachers mentioned that they try to encourage the student activities outside of the classroom, as they notice an improvement in their academic performance, once the students get to know them better. One of the issues pointed out by non-German speaking teachers is the information availability. To their knowledge, even when University provides some kind of support or infrastructure (networks, student clubs), this information is not always reaching the foreign students. Intercultural activities outside of the classroom are not strongly promoted.

Section 4: Challenges encountered by HEI Teachers in solving the identified challenges.



Challenges observed by the teachers

1. Lack of understanding of the local cultural context when interacting with teaching staff or peers
2. Miscommunication with German speaking students
3. Lack the ability to cope with the teaching methods used in university
4. Language barrier
5. The inability to understand what is expected from various assignments

Teaching staff, who have contributed to this report, are working with the small to medium sized student groups (10-25 students in the classroom). The student groups are mixed nationality and mixed gender. The interviewed teachers work in various contexts - some are head teachers leading the course, some are facilitating laboratory projects.

Most of the teachers observed the previously listed challenges in their work context to various degrees. Lack of understanding of the local cultural context has been observed especially in more practical assignments, where international and local students have to collaborate in a project based learning, which also includes practical application, e.g. doing visits in local companies, approaching German speaking experts, doing field research, implementing solutions in real life. Teachers reported that students coming from different countries or even continents, besides language barrier, also have difficulties in understanding local cultural and communication specialties. The challenge in dealing with these issues as a teacher is multifaceted, but often relates to lack of time.

Another challenge, related to understanding what is 'expected from various assignments' often leads to another issue - 'the lack of ability to cope with teaching methods used in university'. Both of those challenges are more often observed with newly arrived students who have come from foreign universities, where the teaching process is different. Next to the cultural differences, there's also a miscommunication due to foreign language, e.g. if the teacher is using English as a second language and students use English as a second language, there might be details 'lost in translation'. The challenge to deal with these issues occurs when students don't communicate their inability to understand the methods or expectations, and this becomes clear only during exams or at the end of the semester.

Language barrier in general has been also mentioned as a common issue, that can lead to miscommunication between German and foreign students, as well as students and teaching staff. It happens when English is used as a second language, but also, when communication is unclear and both students and teachers make assumptions instead of asking follow up questions or clarifications.



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Section 5: Initiatives adopted by HEI teachers to solve the problem

1. mixing local and foreign students for group work
2. promoting peer and cooperative learning
3. giving clear instructions and communication

In order to solve intercultural communication challenges, teachers stress the importance of not using ‘one size fits all’ solutions, but instead be agile and take ad-hoc decisions depending on each individual situation.

One of the initiatives taken by teachers - mixing local and foreign students. This helps foreign students understand local contexts, supports language learning, and local students are enriched by different perspectives and experiences. This is especially useful when students have group work and field work - project-based tasks, meeting local stakeholders, looking for internships etc.

Experimenting with the traditional classroom setting and promoting peer/cooperative learning, is another useful strategy for how interviewed teachers foster intercultural communication. For example, encouraging students of different backgrounds to work together. This is also supported by literature. “The cooperative learning environment encourages students to actively assimilate and process the new information, while cross modeling it with fellow classmates (source: Barkley, Major and Cross. 2014). Through verbally expressing their ideas and responding to others, students develop self-confidence, as well as enhance their communication and critical thinking skills which are vital throughout their entire personal and professional life.

Supporting inquiry-based instructions and encouraging students to ask questions and investigate is also a strategy used by teachers to overcome intercultural communication challenges in the classroom. This helps to improve and further develop problem-solving skills, as well as gain a deeper understanding of intercultural issues and interpersonal concepts.



Section 6: Recommendations from students and teachers on how to solve the challenges.

Foreign students recommended having foreign, rather than local students, facilitating the welcome process to new universities. The rationale behind it, more empathic insight into issues, a foreign student could encounter:

“It would be nice if someone who is not German would show me about the university and explain <how things work> because clearly what works for German <students> does not work for me in the same way. Someone to give me support and share his own experience as a foreigner in university.”

Local students, especially the ones who are actively engaged in social student life and university governance, advice foreign students being proactive and seek out the available initiatives offered by universities:

“The university offers special support teams for organisational study related questions for foreign students, also in some assignments special courses to help in that assignment and by encouraging foreign students in participating in student get to know events. This has worked well so far in my opinion.”

As mentioned previously in this report, the issue is often not about the infrastructure or initiatives and support not being available, but being properly communicated.



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