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SCIENTIFIC AND TECHNICAL LANGUAGE IN ENGLISH AND IN GERMAN – DIDACTIC APPROACHES AND THEIR OPPORTUNITY FOR THE INTERNATIONALIZATION OF UNIVERSITIES

Abstract: In this article, I will present characteristics of technical and science-related language training, in the context of higher education in Germany. First, I deal with and reflect on didactic approaches for teaching English as a technical and science-related language. After that, I deal with a critical discussion of German as a technical and scientific language variety. In conclusion, I present perspectives on the interplay between language and (technical) subjects at higher education institutions in Germany (and elsewhere). In addition to a review of relevant literature, I also write about personal experiences at my university, a technical university in Germany.

Keywords: subject-specific language, ESP, EAP, DaF/DaZ, internationalization of universities

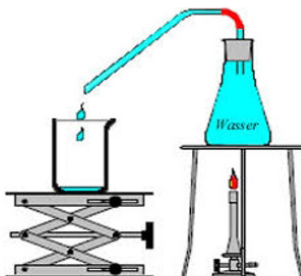
1. CHARACTERISTICS OF SCIENTIFIC LANGUAGE TRAINING SPECIFIC TO HIGHER EDUCATION (HE) INSTITUTIONS

In my own seminars, I like to start with an experiment and ask for the following¹: „Have a conversation in English with your partner about what you did yesterday!” The experiment works in both English and German. I am doing this in order to slowly zoom in on the subject of technical language – from a more general approach of “university-specific language teaching” via “language of science” to “technical languages” of individual disciplines. The task seems

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1 This experiment was invented by a colleague of mine and made available to me. Maria Neumann coordinates a peer-education program entitled „S.o.S. – Studieren ohne Sprachbarrieren” (“Studying without language barriers”) at the Language Center of the Technical University of Braunschweig, cf. Neumann 2019.

to be harmless, but it gradually becomes more difficult. I now ask for a second instruction: “Please describe the following experiment to your partner!”



Picture 1. Setting up a chemical experiment²

This task is obviously less easy, so I ask my students: “What has been your biggest problem?” Almost everyone answers: „The vocabulary is difficult!“ And indeed: What does „erhitzen“ (German) mean in English? Although it is a verb from the general language – should we use „to scald“, „to heat“ or rather „to broil“? With technical words, you often have to pass or rewrite them. Better still, you find technical terms directly using a dictionary or a translation app: „test tube“ for „Reagenzglas“, „Erlenmeyer-flask“ for „Erlenmeyer-Kolben“, „tripod“ or „trivet“ for „Dreifuß“ etc.

Then I ask my students: “Apart from vocabulary, more precise: technical vocabulary – what other difficulties do we encounter in subject-specific communication?” After some reflection, we encounter a lot of more challenges:

We need *grammar*, that is we need to be able to express sequential processes in a sentence and in a text. Secondly, we need a *mental image* of what is being represented. Not all of us handle Bunsen burners and test tubes on a regular basis. Further difficulties may arise, even beyond the experiment: *Eponyms* may occur, when scientific phenomena are referred to by researcher names. An example would be “Blaugas” (German), a word derived from a proper name, developed by the researchers Blau and Riedinger, which is a colorless gas (and definitely not “blue”). Difficulties also arise when words of *everyday language* are ascribed a completely different, specialized meaning in the natural sciences, e.g., in physics, “black light” (“Schwarzlicht”) or the “zeroth approximation” (“nullte Näherung”). However, most challenges in technical settings concern *polysemy*.

The use of general language words in specialized meanings often causes polysemy of specialized terms. In addition to “polysemy”, there are similar terms, in particular “homonymy” and “equivocation”. *Equivocation* (Germ. “Mehrdeutigkeit”) seems to be the umbrella term. Words are considered *homonymous* if their meanings are so different that no similarity can be seen

² <https://www.schule-studium.de/Chemie/Chemieunterricht/Geraetschaften-der-Chemie.html>, accessed March 28, 2025.

between them. *Polysemes* have a common semantic context, *homonyms* don't. However, a clear demarcation between *polysemy* and *homonymy* is not always possible. It can be doubted whether the traditional distinction between *polysemy* and *homonymy* is of more than etymological value. Some linguists (including myself) therefore suggest to speak either in the (softened) sense of *polysemy*, or instead of *polysemy/homonymy* more generally of (*lexical*) *ambiguity* or *equivocation*. The literature is well differentiated and definitions of these terms would require a separate article.

Polysemy can arise in a number of ways. The "strategies" of polysemy are *metaphor* (figurative use), *metonymy* (non-literal use), *borrowing of meaning* (extended use), *elliptical use* (omitting use), *revival of archaisms* (resuming use), or *technical language differentiation of terminology*.

According to the Guinness Book of Records, the German word "Läufer" (Engl. "runner") has the most meanings, namely 24.³ A "Läufer" is, among other things, a row of paving stones, a long narrow format in carpeting, an impeller in a flow machine and a figure in chess. All of them use different strategies: a movable part used for accurate reading and setting of the various scales in the slide rule (metonymy: non-literal use); a young pig, heavier than a piglet (revival of archaisms: resuming use)⁴; a rotating part of a machine in the field of technology (borrowing of meaning: extended use). Other prominent German polysemes are "die Bank" (bank) (metonymy: non-literal use)⁵, "der Wirt" (host) (metaphor: figurative use)⁶, and many more.

In fact, most words are polysemous. Polysemy is considered a natural language normal case and an expression of a linguistic economy principle. Most word in German and English are polysemous, and polysemy plays a particularly strong role in the German language.

Many polysemes arise from the fact that an expression acquires a slightly different meaning through use in a special context. In this way, a new technical term of a technical language can arise from a general term. But the reverse is also possible, when a technical term is used in a general meaning over time. Polysemy can lead to misunderstandings and false conclusions. Therefore, polysemes are considered a potential weakness of automated translation software. In the end, only context and prior knowledge contribute to understanding and avoidance of misunderstanding.

3 <https://blog.supertext.ch/de/2013/05/was-24-laufer-im-duden-zu-suchen-haben/>; accessed March 28, 2025.

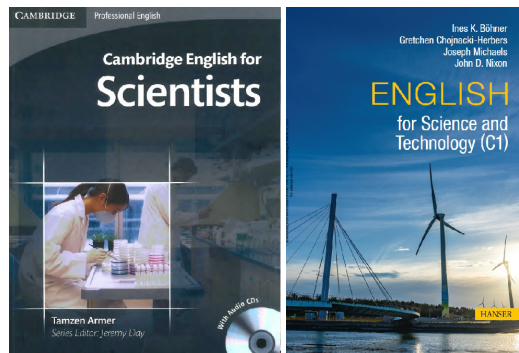
4 In use since the 15th century, actually "inclined to run", later more generally of dogs and then of animals (in German: "eine Hündin ist *läufig*").

5 The money bank is so called because the money changers in the middle ages used to have a bank made of marble to check the authenticity of the coins.

6 In biology, a "Wirt" (host) is an organism that provides resources to a non-species organism called a guest. Depending on the nature of the host-guest relationship, the host may provide the guest with food, shelter, a place to stay, and the opportunity to reproduce or spread.

2. ENGLISH FOR ACADEMIC PURPOSES (EAP) AND ENGLISH FOR SPECIFIC PURPOSES (ESP) AT GERMAN HE INSTITUTIONS AND ELSEWHERE

Before taking on a short foray through textbooks for English and German as a scientific language, a distinction between subject-specific and scientific language can be made, according to German linguist Isabell Deml: A subject-specific language always means the language in a particular subject and besides the one subject-specific language many others exist. The term “scientific language” or “languages of science”, on the other hand, refers to a use of language which can be described as typically scientific and which should also be found in all scientific disciplines due to the fields of action peculiar to all scientific disciplines (cf. Deml 2015: 25). In German-language linguistics, there is usually a strict distinction between the two terms. Yet in English-language literature, the transitions seem to me to be more fluid (cf. Hyland 2017).



Picture 2. Two examples for EAP and ESP textbooks
– Armer (2011) and Böhner et al. (2024)

“Cambridge English for Scientists” (Armer 2011) is aimed at students and scientists with English skills at the intermediate or upper intermediate level, in the taxonomy of the CEFR at levels B1 and B2. This is the level that high school graduates should have when they begin their studies at a university. The book is addressed to students and scientists who need English for research or teaching in a scientific subject. A specific subject is not specified, so the book is in principle addressed to students and scientists of all scientific subjects. Thus, it fulfills the characteristics of a scientific textbook, but due to its concentration on the natural sciences, it also bears the characteristics of a subject-specific textbook (whereby subject in this case would be a group of subjects, the natural sciences). Finally, “Cambridge English for Scientists” belongs to both scientific language and subject-specific language training. On the one hand, it contains exercises with authentic subject-specific texts that come very close to individual

subject-specific languages. On the other hand, it contains more general scientific language exercises, such as applying for research funding or presenting and networking at conferences. The EAP/ESP-training takes place on different levels:

- Scientific thinking and judgment: One exercise is based on an authentic text not presented here by a student who has written down notes on a received research paper. Based on his excerpts and comments, learners should now develop an awareness of the common quality criteria of empirical research. In particular, they should use the student's notes to assess whether the received research meets the following criteria: credibility, originality, reliability (reliability of scientific measurements), significance, validity (congruence of the content of an empirical measurement with a logical measurement concept; degree of accuracy with which measurements are made).
- Cultural conventions in science: Exercises will generate awareness of communicative behavior in scientific workgroups. In particular, they address the concept of appropriateness, which is realized differently in different languages and cultures – including different scientific cultures. For example, politeness is expressed more indirectly and subtly in English than in German.
- Science-related online communication: operates rather with different means of speech than texts in scientific journals. Written science-related online communication in forums and blogs exhibits characteristics of spoken language.
- Describing discontinuous representations: in particular with graphs and tables, requires a special technical understanding and specific scientific linguistic forms of expression. Graphics have a tendency to a language *sui generis*, but in scientific discourse they also have to be formulated in words and sentences.
- Text coherence trains the scientific text genre of literature evaluation. In particular, text coherence is established through linguistic connectors that provide cohesion to a text. EAP exercises are trained at text, sentence and at word level.

Böhner's et al. (2024) textbook is structured differently. Unlike Armer (2011), which oscillates between ESP and EAP, Böhner et al. have clearly opted for the former. The authors are English instructors from the University of Stuttgart's Language Center, with broad experience. The chapters are divided into current scientific topics together with the latest literature: Water Purification, Biomimicry, Autonomous Driving, Wind Turbines, Green Aviation, Satellites and Space Debris, Particle Physics, Materials, High-rise and Skyscraper Construction, and Bridges. Appendices follow: "Reading Numbers Aloud in English", "Mathematical

Symbols and Formulae”, “Example of a Lab Report” and “Student’s Lexicon”. Finally, solutions are provided for all chapters. Some of the tasks within the chapters are similar to those in Armer (2011): “Giving Instructions”, “Process Description”, “Writing a Lab Report” etc. But the tasks are even more in-depth in terms of language: “False Friends”, “Label the Illustration”, “Punctuation”, “Plural Forms”, “Discourse markers and Registers” etc. British English is practiced as well as American and Canadian English. Some exercises are explicitly designed for courses at German universities (contrastive language exercises English vs. German), others could also be used elsewhere.

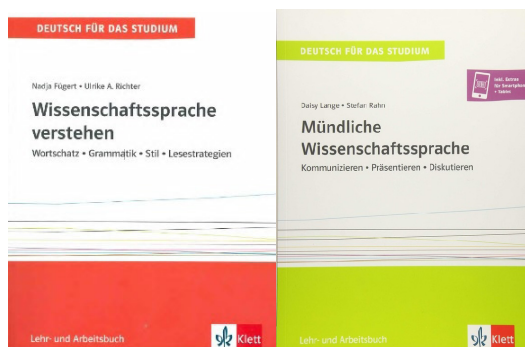
3. TEXTBOOKS FOR GERMAN AS A FOREIGN LANGUAGE (DAF) AT GERMAN HE INSTITUTIONS AND ELSEWHERE

Does the importance of English as a language of science automatically imply the unimportance of German as a language of science? There are good reasons against such a view:

- Preservation of a collective cultural capital: argument, which aims at the value of linguistic and cultural diversity in itself.
- Preservation of the modes of reasoning, perception and approach associated with a language: argument, which goes back to the (controversial) Sapir-Whorf hypothesis.
- Guarantee of scientific thinking and work of German first language learners at the highest level: argument that the mastery of a language has an impact on the accuracy of thinking, on stylistic nuances, associations, imagery, innovativeness, creativity and hypothesis formation.
- Protection of humanities and social sciences, which are nationally and generally language-based to a greater extent: argument that language for STEM subjects is purely instrumental and thus also relatively arbitrary; but in the humanities and social sciences knowledge formation takes place essentially through and in language.
- Securing the transfer of knowledge expert-layman: argument that scientific knowledge must be communicated to society, and that this works best in the national language (cf. Hettiger 2019: 218).

Another essential argument for promoting German as a language of science is often forgotten: The enthusiasm of foreign students and scholars for the German language and culture. The social surveys of the Deutsche Studentenwerk (German Student Union) regularly ask international students about their motivation for studying in Germany. The results underline the outstanding importance of language and culture for the study of foreign students in Germany. Improving language skills regularly ranks among the top list of country-related motives for studying in Germany. The survey sums it up: “As many as 46 percent state that [internationals] want to improve their language skills” (Kroher 2023: 36).

With these arguments, it makes sense that textbooks oriented towards scientific language require not only English but also German. Here is an exemplary look at the textbooks from the publishers Klett and Hueber, which have been dealing with the topic of “German scientific language” from a DaF/DaZ⁷ perspective for several years.



Picture 3. Two examples for DaF/DaZ-textbooks for German scientific (resp. academic) language: Fügert/Richter (2016) and Bayerlein/Buchner (2014)

The selected exercises touch the following and on different levels: scientific practice, scientific communication, scientific language on text, sentence and word level. The training by Bayerlein & Buchner (2014) is not about language as a system, but about functional pragmatics, i.e. practicing a scientific (writing) practice that is realized in the medium of language. Specific learning objectives are linked to competencies in scientific work. Fügert & Richter (2016) train an awareness of norms of scientific work. Loosely speaking, it is about Do's and Don'ts of doing science (this is what science should and should not do...): objectivity and abstraction, prohibition of narration, entertainment and affect, economy with adjectives, etc. Furthermore, internationalisms are part of the training. It is often argued in favor of the German language of science that it contains a large number of lexemes that exist in the same or similar way in many other languages. The fact that there are a lot of *false friends* among them, which can also mislead the understanding, is yet often underestimated. In English, for example, “linguistic” means both “sprachlich” and “linguistisch”, whereas in German, “linguistisch” refers only to the linguistic semantic core. Other thematic exercises follow: Scientific methods are often linguistically realized by functional verb structures (“Funktionsverbgefüge”) with collocations typical for science. Collocations denote the frequent occurrence of adjacent words, e.g., in this case, the combination of “anwendung” and “finden”. *Funktionsverbgefüge* are often more precise than simple verbs. They are found with passive meaning in scientific texts and replace passive constructions.

⁷ DaF („Deutsch als Fremdsprache“) means „German as a Foreign Language“, DaZ („Deutsch als Zweitsprache“) means „German as a Second Language“.

4. DESIDERATA FOR SPECIALIZED LANGUAGE TEACHING AT UNIVERSITIES AND ELSEWHERE

Universities are places with favorable conditions for the teaching and learning of foreign languages:

- There is less time for language training than in schools.
- Receptive knowledge is often sufficient: subject-specific language teaching as “rationalization” of foreign language teaching (cf. Roelcke 2010: 171).
- Specialized language training ensures linguistic ability to act within the subject (cf. Buhlmann/Fearns 1987: 87).

It is not easy to find qualified language teachers at universities. Even more difficult, however, are teachers with a dual qualification for language and subject. What is the ideal profile of a foreign language teacher for subject-specific foreign language instruction? Thorsten Roelcke’s standard work on the subject of “specialist languages” points it out:

- Proficiency in both the learner’s first language and the foreign language
- Knowledge of the corresponding subject area
- Language teaching skills that take into account content and methodological aspects
- Formal: at best, with relevant double degrees

If a double qualification is not possible, the subject-specific knowledge should be compensated for, in particular with cooperative teaching/learning situations and linguistic subject-related team teaching (cf. Roelcke 2010: 175).

What are the perspectives of all the above for the promotion of science and technical language didactics in universities?

Germany is in urgent need of the teaching of specialized languages at universities, which apply in particular to German as a Second Language (DaF/DaZ) and English. First, a needs and language analyses oriented to the subjects is required. Secondly, the development of flanking language support oriented to the needs of the subjects needs to be initiated. At the same time, socio-cultural issues need to be considered (the culture of the subject *and* learning cultures of the countries of origin). A lively cooperation between subjects and language didacticians and the university language center is essential. Not to be forgotten: The expertise of the students within cooperative teaching-learning-situations also needs to be taken into account.

If these desiderata are implemented, three goals can be more easily achieved: language skills in the subject, internationalization of universities and, last but not least, strengthening the employability of our students.

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**ENGLESKI I NEMAČKI JEZIK NAUKE I TEHNIKE –
DIDAKTIČKI PRISTUPI I NJIHOVA PRILIKA ZA INTERNACIONALIZACIJU
UNIVERZITETA**

Rezime

Pojmovi *English for Academic Purposes* i *English for Specific Purposes* vezani su za englesko govorno područje. U nemačkom govornom području obično se koriste termini *Deutsch als Wissenschaftssprache* (nemački kao jezik nauke) i *Deutsch als Fachsprache* (nemački kao jezik struke) (Thielmann 2017). Očito je da postoje i sličnosti i razlike između jezičkih i kulturnih koncepata (Neumann i dr. 2019). U svom radu fokusiraću se na karakteristike i izazove u okviru tercijarnog obrazovanja, potkrepljene praktičnim primerima.

Rad počinje kratkim osvrtom na jedan udžbenik za engleski kao jezik nauke, nakon čega sledi pregled nekoliko nemačkih udžbenika. Već nekoliko godina vodeći izdavači udžbenika za nemački kao strani jezik prepoznaju univerzitete kao ciljnu grupu i izbacuju na tržište udžbenike za koje tvrde da su „specifični za univerzitetski kontekst“. Ali šta tačno čini tu specifičnost univerziteta?

Jedna od pretpostavki jeste da se u nemačkoj lingvistici obično pravi stroga razlika između termina *jezik struke* i *jezik nauke*. U literaturi na engleskom jeziku, čini se

da su te granice fluidnije (Hyland 2017). Generalno gledano, na univerzitetima su povoljni uslovi za učenje i podučavanje stranih jezika struke (manje vremena za jezičku obuku nego u školama, dovoljno receptivnog znanja itd.) (Hettiger 2019). Ključno pitanje jeste pronalaženje odgovarajućih nastavnika za relevantne pozicije na univerzitetima, posebno u univerzitetskim centrima. Kako izgleda idealan profil nastavnika stranog jezika u takvoj instituciji? Kvalifikacije za nastavnike stranih jezika struke na nemačkim univerzitetima retko su jasno definisane ili lako dostupne. Rad se završava željenim ciljevima za nastavu jezika struke na univerzitetima, koji se posebno odnose na nemački kao strani jezik (DaF), naročito u poređenju s engleskim, ali se u principu mogu primeniti na sve jezike koji se predaju na tercijarnom nivou obrazovanja.

Ključne reči: jezik struke, ESP, EAP, DaF/DaZ, internacionalizacija univerziteta