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# Fostering Subject Specific Language Abilities of Future Chemistry Teachers

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## Abstract
*In chemistry lessons teachers and students have to deal with chemical formula, technical terms (e.g. oxidation, chemical reaction) and specific textual forms (e.g. lab report). As different research programs show, there is a high correlation between language and content learning. Hence subject specific language is of high relevance in chemistry lessons and also in chemistry teacher training programs.*
*Regarding combining language and content learning text competence is important. This combines the skills to pick information from written texts and use this information to gain new knowledge.*
*Future chemistry teachers have to acquire a highly specialized academic language at university. Also they have to become aware of the importance of language during their lessons and about the specific needs of their future students at school.*
*The interdisciplinary research project "Fach-ProSa" combining the disciplines of chemistry and german language is concerned with the professional development of future teachers enhancing their subject specific and general language abilities in context with their chemistry studies. It proposes a model for developing future teachers' subject-specific linguistic skills.*
*In this contribution we give a short overview of the research project "Fach-ProSa" and present models for learning settings and materials.*

## 1. Introduction
Up to now diverse language abilities of students at German schools are discussed. Students to whom German is second language and also those students who have low language abilities (e.g. in consequence of a low language use at home) have special needs in school lessons. Otherwise they won´t have the chance to learn at school successfully. Hence to achieve good results in school education students need erudite language abilities [1]. In school subjects like chemistry, biology and physics students have to deal with subject specific language, furthermore. For example chemical formulae, technical terms (e.g. chemical bonding, nucleophile reaction) and also subject specific text forms (e.g. lab report) characterize subject specific language in chemistry education [2, 3]. In consequence science teachers have to support erudite and subject specific language skills of their students. In addition, teacher students have to acquire a highly specialized academic language in science at university in the one hand. They have to become aware of the importance of language in the academic discipline chemistry. On the other hand, teacher students have to be aware of difficulties of subject specific language in school lessons and be aware of specific needs and difficulties their future students have.
Hence teachers need appropriate (erudite and academic) language skills of their own and, in addition, professional knowledge about how to diagnose language abilities and how to give appropriate support to their students.
In result of different debates in politics and society concerning language diversity in school lessons many universities in Germany implemented lectures and seminars concerning needs and appropriate support of students to whom German is second language. These lectures address teacher students of all subjects at once and as result of this these lectures focus on erudite language skills of students in general. Further, teacher students need knowledge about the use of (subject specific) language and support in the context of their school subject (e.g. chemistry). Hence lectures in chemistry and chemistry education have to concern students' subject specific language abilities.
This desideratum is concerned by the program "FachProSa" which is an interdisciplinary research project combining the disciplines of German language and chemistry. The project "FachProSa" intends

to implement learning settings and materials enhancing teacher students´ academic and subject specific language abilities in context with their chemistry studies.

## 2. Theoretical background

According to the focus of the project Fach-ProSa on the education of teacher students, the theoretical background of teachers´ professional knowledge is discussed in the following. Shulman [4] suggested the concept of pedagogical content knowledge (PCK) to analyze teachers' professionalized knowledge. Shulman introduced PCK as amalgam of teachers' pedagogical and content knowledge. Further, different research has been carried out investigating the different domains of PCK since then. Park and Oliver resume six domains of science teachers´ PCK [5]:

- Orientation to Teaching Science
- Knowledge of Students' Understanding of Science
- Knowledge of Science Curriculum
- Knowledge of Assessment of Science Learning
- Knowledge of Instructional Strategies and Representation for Teaching Science
- Self-efficacy

According to enhancing teacher students´ academic and subject specific language abilities in context with their chemistry studies various aspects of language, of language in the specific subjects and of language awareness are focused. As research in foreign language acquisition and foreign language teaching shows that development of language awareness supports (language) learning [6]. *"Language Awareness, in the tradition of Hawkins (1987), should be viewed as the bridging agent in the curriculum, linking home and school languages, inside and outside the classroom experiences and the inner personal self with the social context in which the learner lives."* [6,p.11]. Andrews suggests concerning PCK in the context of language education the concept of teacher language awareness, that refers to the awareness a teacher must have concerning his/her own language use and the role of language in learning settings [7]. Hence according to the importance of subject specific language in science education science teachers have to be aware of their own subject specific language use and the relevance of subject specific language in science education.

## 3. The Model "Fach-ProSa"

Including the development of professional skills in linguistically supportive teaching with science teachers' PCK, each component in the model PCK for science teachers' training is expanded by the factor 'language in science' (fig. 1). Therefore the concept of teachers' language awareness is important.

- To the domain "Orientation to Science Teaching" orientations and beliefs concerning the relevance of language and subject specific language in science and science education is added.
- Within the domain "Knowledge of Assessment" aspects like knowledge and skills in terms of language level/language competence are pointed out. The focus here is diagnosis and test of (subject specific) language competence levels.
- The domain "Knowledge of Instructional Strategies and Representations" accentuates approaches to teach topics in a relevant manner. Regarding adding aspects of erudite and subject specific language it is important to develop teacher students´ abilities to create a framework for language supporting strategies. E.g. different scaffolding approaches can be discussed.
- Within the component "Knowledge of Students´ Understanding of Science" it is intended to raise teacher students´ awareness of language challenges and the language-bound concepts students have in mind (common and subject specific meaning of different expressions). In addition, teacher students have to think about students' prior knowledge and subject specific vocabulary. For example dual meaning vocabulary [8] in correlation to conceptual change theories [e.g. 9] is discussed.
- To the domain "Knowledge of Science Curriculum" teachers' awareness of language- related skills involving subject-specific terminology, the use of language for specific contexts and the knowledge of how to create curricular-based learning settings is added.
- Within the component "Teacher Efficacy" the programme Fach-ProSa intends to establish teacher students' confidence in their ability to use subject-specific language and teacher students´ confidence in their ability to promote language-specific skills of students at school.

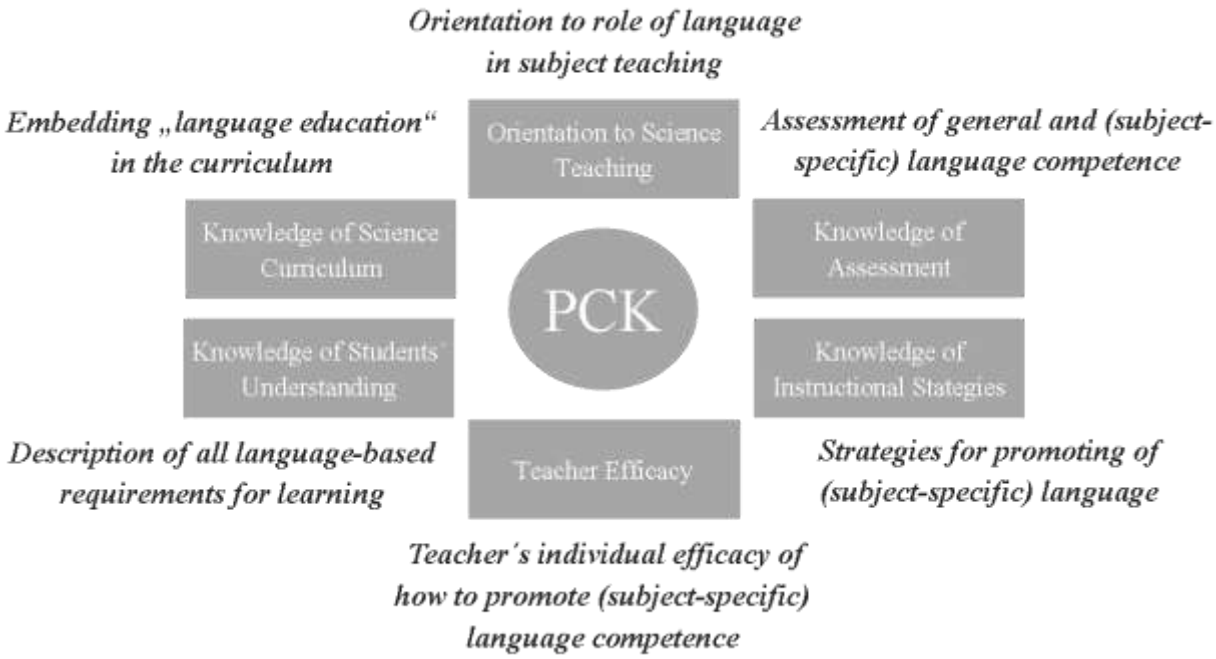


Figure 1: “Fach-Prosa”: a model for teacher training in developing professional skills for linguistically supportive teaching [10]

Based on this theory, a deduced model for a curriculum of teacher students´ professionalization has been developed (fig. 2). Further, different learning settings and materials have been and are still implemented in chemistry education at the University of Flensburg.
In the first semester the learning materials concern raising awareness about the relevance of subject-specific language and the extent of teacher students´ ability to use subject-specific language. In the following semesters teacher student get to know about theoretical backgrounds concerning erudite and subject specific language in the context of chemistry education. In the fourth or fifth semester teacher students´ observe and reflect the role of subject specific and erudite language in chemistry lessons during a practical training as an assistant-teacher at school. At the end special effort is given to the development of teaching profession. Teacher students design language promoting activities for chemistry lessons. They develop learning setting and materials. In their master studies teacher students use this learning settings and materials in a semester in which students take part in a practical training over a whole semester.

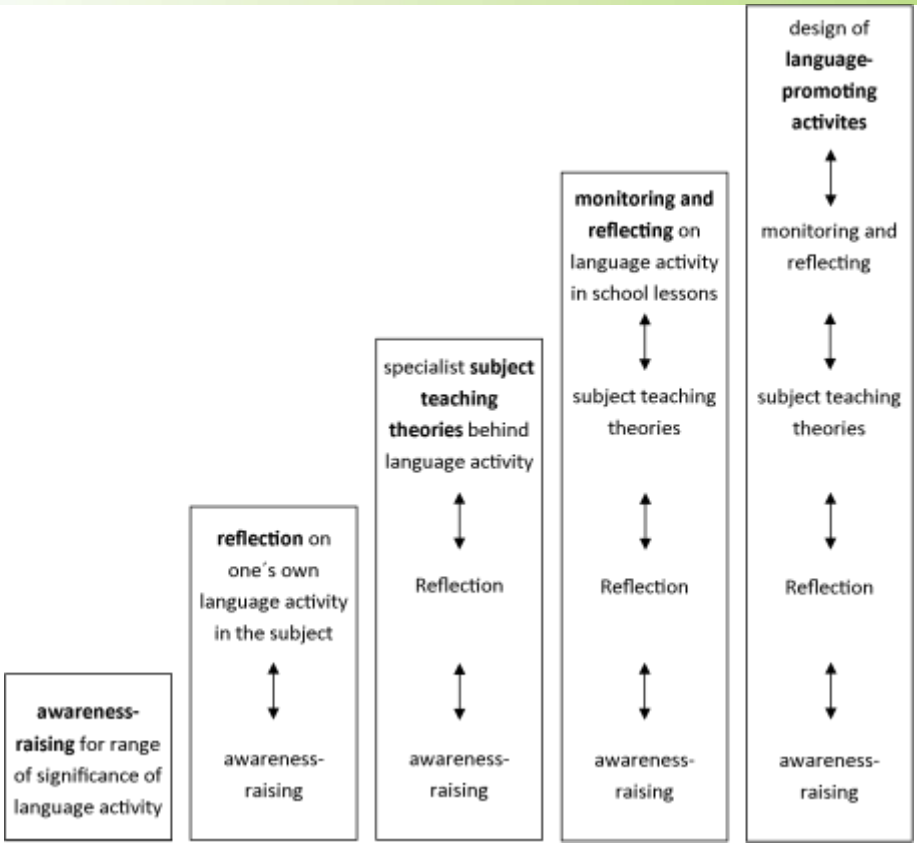


Figure 2: Curriculum of "Fach-Prosa" developing professional skills for linguistically supportive teaching in science education [10]

## 4. Outlook

In this contribution we presented the model "Fach-Prosa" which improves the education of teacher students in chemistry in a way, that at the end of teacher training these teacher students are able to teach students in classes with high language diversity. Up to now still different learning setting and learning materials are developed and evaluated. Therefore different test instruments concerning teacher students´ language abilities and self-efficacy are developed. Hence different empirical studies with this focus are carried out at the moment.

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