

Pre-service teachers' understanding of linguistically sensitive subject teaching and academic language: influencing factors in university education

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Subject teaching and learning are hardly possible without language competence; teachers are therefore required to conceptualize subject lessons in a language-aware manner. Many universities in Germany respond by offering additional modules or integrating language support into subject didactics—often without accompanying empirical research. This study examines pre-service teachers' understanding of Linguistically Sensitive Subject Teaching and academic language, as well as factors influencing this understanding in the context of university teaching, including both learning and individual beliefs. Different conceptual knowledge bases lead to diverging understandings of these concepts among pre-service teachers.

Keywords: Teacher Professional Development, German as a second language, Linguistically Sensitive Subject Teaching, Academic Language, learning opportunities

Zum Verständnis von Lehramtsstudierenden von sprachsensiblen Fachunterricht und Bildungssprache: Eine Untersuchung der Einflussfaktoren in der Hochschullehre

Ohne Sprachkompetenz sind fachliches Lehren und Lernen kaum möglich; Lehrkräfte sollen daher sprachbewusst unterrichten. Viele lehramtsbildende Universitäten reagieren mit Zusatzmodulen oder sprachbildenden Anteilen in den Fachdidaktiken, oft ohne empirische Begleitung. Die vorliegende Studie untersucht das Verständnis von Lehramtsstudierenden hinsichtlich sprachsensiblen Fachunterrichts und Bildungssprache sowie Einflussfaktoren auf dieses Verständnis im Kontext der Hochschullehre, wobei sowohl Lerngelegenheiten als auch individuelle Überzeugungen berücksichtigt werden. Unterschiedliche konzeptionelle Wissensbestände führen bei Lehramtsstudierenden zu divergierenden Verständnissen dieser Konzepte.

Schlagwörter: Lehrkräfteprofessionalisierung, Deutsch als Zweitsprache, Sprachsensibler Fachunterricht, Bildungssprache, Lerngelegenheiten

1 Introduction

Students' language competence has proven to be one of the most important factors influencing subject performance (Böhme et al. 2017, 193; Prediger et al. 2015). Against this background, teachers are required to design their lessons in a language-aware manner, to acquire knowledge of language as a medium in the classroom and to support their students in the continuous development of their language skills. Consequently, teacher education

plays a key role in preparing pre-service teachers for Linguistically Sensitive Subject Teaching (hereafter: LST). "Subject" refers primarily to school subjects and subject teaching in school contexts unless stated otherwise. Teacher training universities in Germany have responded to these demands in different ways including through additional qualifications and interdisciplinary modules. In recent years, universities in Lower Saxony have focused on subject-integrated qualifications for pre-service teachers of all subjects (Neumann & Casper-Hehne 2016), but these programs have rarely been systematically monitored empirically. Concepts of LST vary considerably in their theoretical focus and pedagogical implementation, as discussed in Section 2.1. These include approaches related to German as a Second Language (GSL), competence models (e.g., DaZKom, SprachKoPF), and broader didactic frameworks such as scaffolding (Kniffka 2024) or LST (Becker-Mrotzek & Roth 2017). As a result, terminology and underlying concepts are not used consistently. This lack of consistency is reinforced by the abstract nature of educational policy terms such as language education, language support, or LST (Feigenspan & Michalak 2023; Leisen 2010), which is also referred to as Linguistically Responsive Teaching (LRT) in Anglo-American contexts (Lucas et al. 2008). Consequently, these concepts are implemented in different ways in teacher education. The focus may be either on the development of academic language (AL) skills in all students (language education) or on students acquiring GSL (language promotion) (Jostes 2017). In subject didactics at German universities, aspects of language that legitimately serve the subject culture are addressed, such as the acquisition of text types and registers (everyday language vs. technical language), acquisition of subject or "basic" concepts (Feigenspan & Michalak 2023, 80) or, in the language subjects, intercomprehensive reception (Hufeisen & Marx 2014). This disciplinary variation contributes to heterogeneous understandings of linguistically sensitive concepts. At the forefront of educational policy efforts in Germany is the development of AL across and throughout all subjects (Brandt & Gogolin 2016). "This means that teachers of all subjects must develop an idea of what constitutes academic language as opposed to everyday or colloquial language" (Rost-Roth 2017, 71). It remains unclear how pre-service teachers understand key concepts such as AL and LST, and how their understanding is shaped by the heterogeneous approaches used in teacher education. This study examines pre-service teachers' understanding of LST and AL in order to identify the factors that influence this understanding. Section 2 outlines the theoretical background, Section 3 presents the methods, Section 4 the results, and Section 5 discusses the findings.

2 Theoretical background

2.1 Language education and promotion in the subject

This section outlines central concepts related to language education and LST. The debate on subject-integrated language education intensified following increased immigration to Germany in 2015, when many newly immigrated children and adolescents entered mainstream classrooms. Language education within subject teaching is relevant not only for second language learners but for all students due to increasing language demands throughout schooling. One prominent approach to the interlinked promotion of language

and subject-related skills in Germany is LST, an umbrella term for concepts differentiated in subject didactics and educational sciences, such as language-aware, language-intensive, language-promoting, or linguistically sensitive subject teaching (see Münch-Manková 2024). According to Woerfel and Giesau (2018), LST refers to teaching concepts that consciously use language as a means of thinking and communication in order to link subject-related and linguistic learning, with targeted language support integrated into lessons. Within this broader framework, scaffolding is a central pedagogical principle but is not equivalent to LST: while LST refers to an overarching didactic framework, scaffolding operationalizes language support at the micro level of classroom interaction and the macro level of materials (e.g., Gibbons 2002; Kniffka 2024). Internationally, Content and Language Integrated Learning (CLIL) refers to an educational approach that integrates subject and language learning in a dual-focused manner (Haataja 2013). While typically situated in foreign language contexts, CLIL shares with LST the assumption that language and content learning are interdependent but differs in its implementation: CLIL often constitutes an additional, positively connoted programme, whereas LST in German-speaking contexts is primarily framed as a response to linguistic heterogeneity in mainstream classrooms. Building on this understanding, this study follows Leisen's (2017) approach, which emphasizes scaffolding to support students' subject-specific language use, and extends it through Tajmel's concept of Critical-Reflective Language Aware Subject Teaching (Tajmel 2017). Tajmel broadens this perspective by including linguistic-cognitive aspects, hegemonic dimensions, affective aspects, and socio-political responsibility. In order to provide equitable education, teachers need language awareness to promote AL and teach in a diversity- and discrimination-sensitive manner (Tajmel & Hägi-Mead 2017, 10). Tajmel and Hägi-Mead (2017, 72) identify three central categories: responsibility, transparency of language learning objectives, and know-how. These principles serve as the conceptual basis for the hypotheses presented in Section 3. Academic language is not equated with LST but is instead understood as a linguistic dimension addressed within it: while AL refers to school-based linguistic resources and discourse practices, LST refers to pedagogical approaches that make these resources accessible in subject teaching. In this study, these dimensions are not operationalized as a full competence model; instead, the focus is placed on pre-service teachers' concept-related understanding of LST and AL as expressed in their definitions. Beliefs, perceived responsibilities, and reported learning opportunities are treated as analytically distinct factors that may influence this understanding.

2.2 Academic language (AL)

Academic language (AL) is a key prerequisite for subject learning. Students' language skills are constitutive of the acquisition of knowledge (e.g., Fillmore & Snow 2018; Gürsoy et al. 2013). AL appears to be more decisive for success at school in Germany than everyday language skills (Fornol & Hövelbrinks 2019, 498-499). AL is understood in terms of the German concept of "Bildungssprache", while also drawing on international approaches that conceptualize academic language as a school-based language practice (e.g., Schleppegrell 2012). Drawing on Feilke (2012, 5), AL can be described as school-typical forms of language and communication that are oriented toward learning processes and

mediate between scientific or specialized knowledge and everyday experience. This mediation is characterized by features such as written language, condensation, and generalization. The features of German AL are the subject of ongoing debate, particularly with regard to their status and function and operationalization (Binanzer et al. 2024). Morphosyntactic features such as nominalizations or passive constructions are often described as typical characteristics of AL. Such feature-based approaches have been criticized as being structurally too narrow and contextually too broad, since these forms also occur in other registers and do not sufficiently capture functional and discourse-related dimensions (Morek & Heller 2012; Steinhoff 2019). Empirical findings suggest that linguistic complexity does not necessarily correspond to increased task difficulty (Leiss et al. 2018). Instead, Steinhoff (2019) highlights instructional operators such as explaining, describing, and arguing as central elements of subject-specific discourse practices and conceptual learning. It remains unclear how pre-service teachers conceptualize these characteristics of AL and how they relate them to subject teaching.

2.3 Qualification for LST for pre-service teachers in Germany

In Germany, the qualification of pre-service teachers for LST remains unevenly developed. Even though Pedagogical Language Knowledge (PLK), i.e., teachers' knowledge of how language functions in subject-specific teaching and learning (Bunch 2013), and necessary knowledge about multilingual learning processes in subject teaching (TALK: Teachers' awareness of language knowledge; Gierlinger 2023, a framework for language-aware competences in multilingual classrooms) are considered essential for reducing language-related inequalities in the education system (Gogolin & Duarte 2016), their inclusion in current models of teacher professionalism in Germany remains limited (Brandt et al. 2023, 3).

The understanding and conceptualization of language-integrated learning seem to vary between language-driven and content-driven teachers (Villabona & Cenoz 2022). In Germany, pre-service teachers (N=125) report not feeling adequately qualified for LST (Tajmel 2010). In order to implement LST effectively, it is also necessary to identify the (academic) language requirements of the subject (Leisen 2010; Tajmel & Hägi-Mead 2017). The majority of pre-service teachers are only able to identify superficial features at the conceptual and vocabulary levels in relation to AL (Brandt et al. 2023, 16; Drumm 2016; Wallner 2020). A study by Ehmke and Lemmrich (2018) among pre-service teachers (N=496) also showed that more than half of them had either not engaged with topics such as AL or scaffolding during their studies or had encountered them in only a single session. Even rarer are in-depth learning opportunities such as analyzing texts with regard to their linguistic complexity or LST planning (ibid., 212). Recent studies indicate that learning opportunities related to GSL influences the GSL competencies of pre-service teachers (e.g., Ehmke & Lemmrich 2018; Paetsch et al. 2019).

Professional approaches to linguistic heterogeneity can also be linked to pre-service teachers' beliefs. In this study, beliefs are understood as pre-service teachers' subjective assumptions about the role of language in subject teaching and learning. Since LST is implemented in linguistically heterogeneous and multilingual classrooms, beliefs about multilin-

gualism are closely related to pre-service teachers' understanding of LST and AL. In Germany, the concept of a predominant "monolingual habitus" has been widely discussed (Gogolin 2008). Recent questionnaire studies among pre-service teachers indicate a positive development in beliefs about multilingualism in the classroom (Hammer et al. 2016), which may be influenced by the number of courses attended (Fischer & Ehmke 2019). Pre-service teachers also tend to hold positive attitudes toward LST (Brandt et al. 2023, 16), which the authors interpret as an indication of the perceived relevance of LST.

How LST or GSL is anchored in subject contexts in the first phase of teacher training varies in the German federal states and depends on the subjects studied and the teacher qualification for a specific type of school (Baumann 2017). a) In GSL modules, which are not compulsory in all federal states, it remains unclear to what extent pre-service teachers learn GSL in subject-specific contexts or about LST. b) LST is integrated into German teacher education programs through optional certificate programs or as a cross-cutting topic, particularly in subject didactics courses. The subject didactics have their own approaches to the linguistic nature of their subject in accordance with their subject culture (Becker-Mrotzek et al. 2013).

3 Research questions and methods

Against the background of the conceptual heterogeneity and lack of clarity outlined above, this study investigates pre-service teachers' understanding of LST¹ and AL. The study is situated at Carl von Ossietzky University of Oldenburg (Lower Saxony, Germany), where LST is implemented as a cross-cutting topic. Additionally, the study documents how these concepts and related learning opportunities are addressed in university teaching. There are no compulsory GSL modules at the University of Oldenburg, but there are integrative efforts to implement LST as a cross-cutting topic in teacher training courses. Therefore, pre-service teachers' understanding of LST and AL can be used as an indicator of how and what is taught in university teaching. Based on this assumption, it is expected that the higher the subjectively perceived importance of language education and promotion in the subject and the more positive the beliefs about LST, the more differentiated the understanding of LST and AL will be, and that pre-service teachers are more likely to see the need to make their later teaching linguistically sensitive. In this study, LST and AL are treated as closely related but analytically distinct constructs: LST refers to pedagogical approaches, whereas AL refers to school-based linguistic resources and discourse practices. Here, "understanding" refers to the degree of conceptual differentiation in pre-service teachers' open-ended accounts of LST and AL rather than to fully developed professional competence in the sense of combined knowledge, action, and attitudes. Professional beliefs are therefore not treated as part of the dependent variable but as potential predictors.

Based on previous research on professionalization for language education (e.g., Andrews 2007; Koch-Priewe & Krüger-Potratz 2016), we initially assumed that pre-service teachers

¹ Since the adjective "linguistically sensitive" appears in the official name of the cross-cutting topic and in the previous implementation efforts of the University of Oldenburg, it was also used in the questionnaire and in this article. However, the authors prefer the concept of *Critical-reflective Language Aware Subject Teaching*.

of language subjects would have a more pronounced understanding of the topic. It can therefore be assumed that one important factor influencing the understanding of LST and AL is the study of linguistics, German or German as a Second and Foreign Language² (**H1**). During further research, three new hypotheses have emerged. The last hypothesis H4 comprises five sublevels, but only H4a-b will be outlined here due to space constraints.

Regarding LST, beliefs may influence the willingness to engage with the topic and process relevant information (Ricart Brede 2019, 30). The first principle of Language Aware Subject Teaching (responsibility) (Tajmel & Hägi-Mead 2017) implies that teachers' beliefs about the role of language in subject teaching may influence how they engage with LST. The more strongly pre-service teachers perceive language learning as an integral part of subject teaching, the more likely they are to have a differentiated understanding of LST and AL (H2). This assumption is based on the idea that engagement with language-related aspects of subject teaching may foster a more differentiated understanding of LST and AL.

According to Tajmel and Hägi-Mead (2017), the second principle is the transparency of objectives, meaning that language learning objectives are made explicit. Language learning objectives include, for example, the promotion of register acquisition, knowledge of text types/genres, the acquisition of writing and reading skills, language awareness and subject-specific discursive functions (arguing, describing, explaining, etc.). Since language learning objectives are not part of the dependent variable as operationalized here, it is assumed that their inclusion in university teaching is associated with a more differentiated understanding of LST and AL. **H3**: The more frequently language learning objectives related to subject teaching are addressed in university didactics courses, the more differentiated the pre-service teachers' understanding of LST and AL will be.

The final principle, the know-how, involves teachers providing linguistic structures and methods that enable appropriate language use and discourse management (Tajmel & Hägi-Mead 2017). GSL topics and methodological-didactic approaches used in university teaching are therefore considered essential for developing teachers' expertise in LST and are examined as part of a fourth hypothesis: **H4**: The more frequently LST topics are mentioned and LST methods are provided, the more differentiated the understanding of LST and AL will be.

3.1 Sample

The hypotheses were tested based on the responses of 396 pre-service teachers enrolled in a master's teacher education program (N= 1,679 in the winter semester 2021/2022) as part of an online survey. After data cleaning, responses from 202 participants could be evaluated, 86 identified as female, 17 as male and 99 remained undeclared. The majority of respondents (89 %) were between 18 and 30 years old. At the time of the survey, most participants were studying to become teachers for upper secondary education (48 %), followed by elementary education (15 %), lower secondary education (8 %), special education (21 %) and vocational school/business education (7 %). In terms of subjects, 17 % were

² Darsow, Wagner and Paetsch (2019) found a performance advantage for pre-service teachers of German, foreign languages and primary school pedagogy in the evaluation of the Berlin GSL modules. However, this was only maintained in the post-test for foreign language pre-service teachers.

studying German or GSL/GFL, 12 % biology, 8% mathematics, 7 % each religion, physics and English studies, 6% each history, subject education, economics/politics and the remaining participants studied subjects such as special education, art, music, philosophy, chemistry, sport, computer science, technology, foreign languages, etc. 26 % of the pre-service teachers were studying language-related subjects, 67 % were not studying philology, and 7 % of the respondents did not specify their field of study. A chi-square test with a p-value of .155 confirms that there is no statistically significant correlation between language studies and gender.

3.2 Data collection methods

To examine pre-service teachers' understanding of LST and AL and their perceived LST-related learning opportunities, a questionnaire was developed based on Riebling (2013) and the principles of Language Aware Subject Teaching (Tajmel & Hägi-Mead 2017). It included 19 questions with frequency items, agreement scales, self-assessments, and open-ended formats. Items 1–2 focused on conceptual understanding of LST and AL, while items 3–4 addressed subject-specific language use, including typical tasks and genres. Items 5–12 captured the perceived integration of LST-related content and methods into university teaching, including beliefs about language use in school. Questions 13–18 covered socio-demographic information and self-assessed relevance of language-related knowledge and skills.

The questionnaire was administered online (LimeSurvey) between November 2021 and April 2022. The link was distributed via the mailing list of the Didactic Center of the University of Oldenburg and in selected didactics seminars. The questionnaire was administered in German; all items were translated into English for reporting purposes.

3.3 Analysis methods

To assess pre-service teachers' understanding of LST and AL, responses to open-ended questions were externally rated on a scale from 1 to 10, with higher scores indicating a more differentiated conceptual understanding rather than practical teaching performance. To increase reliability, the ratings were based on a theory-guided coding rubric with predefined criteria and were independently checked by a second rater; ambiguous cases were discussed until agreement was reached prior to analysis. The remaining questionnaire items were used to capture potential influencing factors and were analyzed quantitatively.

The rating criteria were derived from the definition of LST by Woerfel and Giesau (2018), the framework of Tajmel and Hägi-Mead (2017), and the concept of AL according to Feilke (2012). Responses were rated higher when they addressed multiple conceptually relevant dimensions (e.g., cognitive-linguistic, social, or hegemonic aspects) rather than isolated features. H1 and H2 were tested using regression analyses (Blasius 1988), with H2 based on the items presented in Fig. 1.

Statement	dis-agree	rather dis-agree	rather agree	agree
a. Every lesson is also a language lesson.		3%	17%	79%
b. Subject teaching cannot provide language support.	58%	30%	9%	3%
c. Subject lessons have a high potential for language learning.		15%	42%	43%
d. Language education and promotion must be based on the subject, i.e. geared towards the subject content.	1%	16%	49%	34%
e. Language education and support slow down the progression in subject lessons.	26%	52%	21%	1%
f. Language education and promotion benefit the acquisition of content knowledge.		6%	28%	66%
g. Language education and promotion are not tasks of subject lessons.	77%	21%	2%	
h. Language skills must be a prerequisite in subject lessons.	25%	25%	35%	5%
i. Content and language learning cannot be separated from each other and are acquired in parallel in subject lessons.	4%	8%	28%	60%

Fig. 1: Items for question 5: To what extent do you agree with the following statement?

To verify H3, pre-service teachers were first asked to what extent language learning objectives are addressed in teaching courses (Fig. 2).

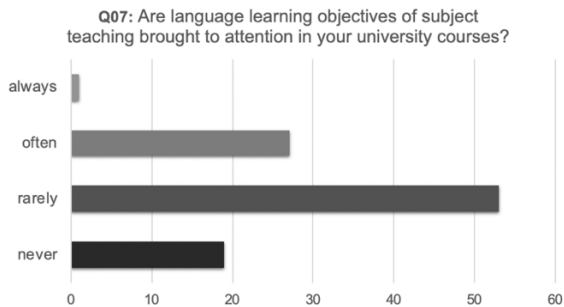


Fig. 2: Language learning objectives of subject teaching in higher education

In the next step, pre-service teachers indicate which learning objectives are particularly emphasized by lecturers in courses (Fig. 3).

Q08: Which linguistic learning objectives of subject teaching are particularly emphasized by lecturers?

1. Acquisition of technical terms at school
2. Acquisition of the grammatical features of technical language (e.g. passive voice, nominalization, logical connectors, etc.)
3. Acquisition of formula and symbolic language
4. Acquisition of skills in dealing with subject-specific texts and genres (e.g. protocol, essay)
5. Acquisition of writing skills
6. Acquisition of reading skills
7. Acquisition of skills in complex oral presentation (presentations etc.)
8. Acquisition of register awareness (e.g. sensitivity to the differences between technical and everyday language and the functionality of technical language)
9. Acquisition of subject-specific language discourse functions (e.g. defining, arguing, describing, etc.)

Fig. 3: Language learning objectives in subject lessons according to Riebling (2013)

To estimate the influence of learning objective transparency, the mentioned language learning objectives were summed for analysis using the coding scheme "never = 0", "rarely = 1", "often = 2" and "always = 3". For example, if a pre-service teacher stated that the acquisition of specialist school vocabulary or the development of writing and reading skills was often addressed by the lecturers, a value of 2 was assigned. Furthermore, the analysis examined whether the presentation of language learning objectives affects the understanding of LST and whether these objectives can be summarized into underlying factors. Based on a correlation matrix of the language learning objectives, an exploratory factor analysis was conducted. Subsequently, a structural equation model (Aichholzer 2017, 7) was used to determine which factors contribute to a differentiated understanding of LST and AL and to what extent. For some analyses, the understanding of LST and AL was combined into a joint indicator (ALST) to capture their empirical co-occurrence in pre-service teachers' conceptualizations. This does not imply the conceptual equivalence of LST and AL. Regression analyses were also conducted for H4. Pre-service teachers were first asked which topics they had already encountered during their university courses and how many in-depth learning opportunities they had had (e.g., reflection on the power of language or the identification of linguistic requirements of subject content).

4 Results

In the external assessment, participants scored an average of 5.07 points on LST and 4.27 points on AL on a scale of 0 to 10. These scores reflect the externally rated level of conceptual understanding based on responses to the open-ended questions, with higher values indicating a more differentiated understanding. Pre-service teachers of language subjects scored an average of 1.13 points higher on LST and 1.71 points higher on AL than pre-service teachers of non-language subjects. The regression analyses show significant correlations with regard to the understanding of LST, with $F(1, 168) = 12.37$ and $p < .001$ and AL with $F(1, 154) = 20.02$ and $p < .001$ (Table 1). The verification of **H1** indicates that pre-service teachers in language degree programs have a more pronounced understanding of LST and AL than their peers in non-language degree programs.

Tab. 1: Regressions on LST/AL with the study subject

Regressions: field of study				
model	I	II	III	IV
depend. variable	LST	AL	LST	AL
German studies	1.269*** (3.66)	1.932*** (4.69)		
Language studies (GSL/GFL)			1.133*** (3.52)	1.711*** (4.47)
constant	4.758*** (28.99)	3.915*** (19.01)	4.721*** (27.58)	3.838*** (17.56)
observations	170	156	170	156
R-square	0.074	0.125	0.069	0.115
adj. R-square	0.068	0.119	0.063	0.109

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1 Results for H2: Correlation between LST/AL and beliefs about the language learning potential in subject teaching

Regarding H2, two significant main effects were identified in a multiple regression, namely the relationship between language learning potential and the epistemic function of language with $F(3, 137)$ and $p < .038$ and $p < .037$ in relation to LST. With regard to AL, a single significant effect was found in the multiple regression for the importance of language for subject knowledge acquisition with $F(3, 144)$ and $p < .011$. Thus, pre-service teachers' perception of the language learning potential of subject teaching ($F(1, 139)$ and $p < .006$) and of the epistemic function of language ($F(1, 158)$ and $p < .000$), had an effect on their understanding of LST. The latter variable also had an effect on the understanding of AL with $F(1, 156)$ and $p < .002$. In a further simple regression, learners' linguistic prerequisites were also significant in relation to LST, with $F(1, 156)$ and $p < .000$, and with $F(1, 156)$ and $p < .050$ in relation to AL (Table 2). Pre-service teachers who negate the statement "language skills must be assumed in subject teaching" showed a more differentiated understanding of LST and AL, which accounts for the negative correlation.

Tab. 2: Areas of responsibility of subject teaching

Responsibilities of the subject teaching								
model	V	VI	VII	VIII	IX	X	XI	XII
depend. Variable	LST	LST	LST	LST	AL	AL	AL	AL
language prerequisite	-0.799*** (-5.73)			-0.165 (-1.01)	-0.390* (-1.98)			0.229 (-1.01)
potential for l. learning		0.574** (2.81)		0.432* (2.10)		0.384 (1.32)		0.153 (0.53)
knowledge acquisition			1.013*** (7.55)	0.388* (2.11)			0.628** (3.13)	0.660* (2.59)
constant	7.037*** (17.81)	3.466*** (5.12)	1.865*** (4.21)	3.027*** (2.93)	5.229*** (10.07)	3.085** (3.21)	2.238** (3.31)	2.194 (1.53)
observations	158	141	160	141	158	148	158	148
R-square	0.156	0.054	0.265	0.105	0.024	0.012	0.059	0.079
adj. R-square	0.150	0.047	0.261	0.085	0.018	0.005	0.053	0.060

4.2 Results for H3: Correlation between LST/AL and language learning objectives of subject teaching

Testing H3 yielded the following results: The more frequently language learning objectives were reported to be addressed by lecturers in university courses, the more differentiated pre-service teachers' understanding of LST and AL was ($F(1, 168)$, $p < .001$; $F(1, 154)$, $p < .001$). For each additional learning objective addressed, understanding was rated 0.29 points higher for LST and 0.28 points higher for AL (Tab. 3). The individual learning objectives showed significant effects for the following variables: Acquisition of technical terms, characteristics of technical language, acquisition of text genres, writing and reading skills, acquisition of register awareness and subject-specific language discourse functions (more narrowly defined as operators).

Tab. 3: Regression of the thematization of learning objectives

Regression Learning objectives		
model	XIII	XIV
dep. variable	LST	AL
lear. objectives	0.293*** (4.77)	0.276*** (3.31)
constant	4.306*** (20.60)	3.618*** (12.11)

observations	170	156
R-square	0.119	0.067
adj. R-square	0.114	0.060

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As the variables correlated significantly and the Kaiser-Meyer-Olkin criterion was fulfilled, an exploratory factor analysis was conducted. The subsequently selected oblique-rotated solution offers two factors (TEXT and DISCOURSE) with factor loadings greater than 0.5. The first factor TEXT consists of writing and reading skills, whereas the second factor DISCOURSE comprises specialized vocabulary, language awareness and discourse functions (Fig. 4). The combined representation in Fig. 4 does not imply conceptual equivalence of LST and AL, but serves to illustrate their joint empirical variation in the data.

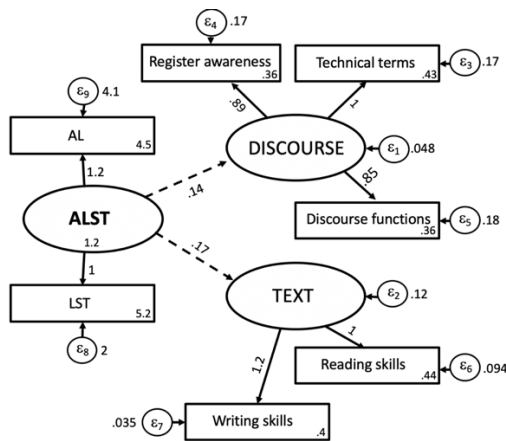


Fig. 4: Regression to learning opportunities with in-depth exercises

Fig. 3 shows how the questionnaire asked for indicators of DISCOURSE and TEXT. In terms of model complexity, the fit indices were RMSEA=.01, SRMR=.044 and CFI =.999. The structural equation model showed that both the DISCOURSE factor ($p < .007$) and TEXT ($p < .009$) had a significant influence on the combined understanding of AL and LST (ALST), which comprises the understanding of AL and the understanding of LST.

4.3 Results for H4: Correlation between LST/AL and LST topics and methods in the university courses

Hypothesis H4a states that addressing LST in university teaching contributes to the understanding of LST and AL. The more frequently LST topics and methods are addressed, the more differentiated the understanding of LST and AL will be. Pre-service teachers were therefore asked which topics they had already encountered in their university didactics courses. They could choose between the following items:

Q09: In the context of your university courses, what topics have you come across within your subject areas?":

- research knowledge on the relationship between language and subject matter (e.g., PISA shock: language proficiency and educational success, textual coherence in task instructions)
- approaches to language and content integrated learning (e.g. through scaffolding)
- Theories of language acquisition
- Elaborated and restricted linguistic registers (e.g. everyday language, educational language, technical language)
- Differences between written and oral communication in the subject
- Language discourse functions in educational standards and curricula
- Structure and function of technical language at school (e.g. grammatical features such as the subjunctive as a means of distance in interpretation)
- Subject-specific text types and genres (e.g. protocol, poems)
- Language-induced conceptual shifts and domain-specific terminology (e.g., 'light and dark' in everyday life, optics, or music)

Fig. 5: LST-Topics in the courses

In simple regressions, significant correlations were found between LST comprehension and curricula ($p < .000$), language acquisition theories ($p < .001$), scaffolding ($p < .000$) and genres ($p < .001$). In multiple regressions, the variable "scaffolding" always remained significant for the understanding of both LST and AL, suggesting that addressing scaffolding methods strengthens general understanding.

In addition to addressing the above-mentioned content, in-depth learning opportunities that not only cover specific topics but also involve the use of LST methods have a constitutive effect on the understanding of LST. Such in-depth learning opportunities can include, for example, identifying requirements, developing expectations, reflecting on subject-specific norms, reflecting on the social – analog and digital – reality of language use among pre-service teachers, etc. In this way, they acquire the know-how needed for their work in linguistically heterogeneous classrooms. To this end, they indicated on a five-point scale from never (0) to always (4) how often they had encountered such exercises involving LST methods in subject-specific didactics or scientific courses. The following overview shows the mean values for these exercises in courses (Fig. 6).

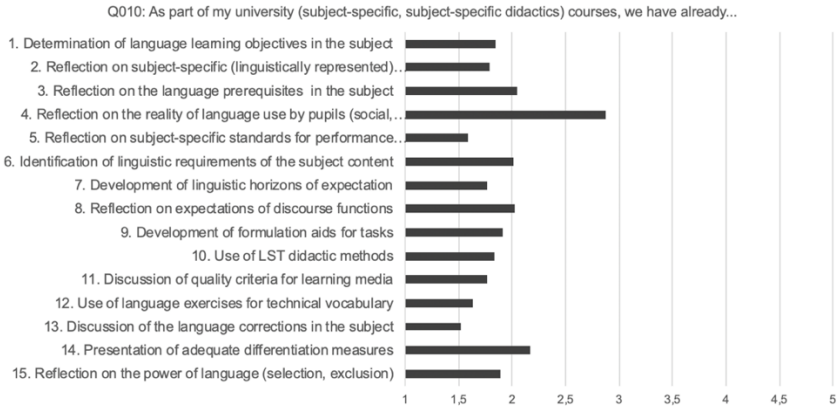


Fig. 6: Deeper learning opportunities with LST-methods in university courses

Mean values rarely exceeded level 2, indicating that in-depth LST learning opportunities were less frequently included in university teaching. Regarding the understanding of LST and AL, the variables reality of language use (no. 4, $p < .000$), formulation aids (no. 9, $p < .009$), expectations of discourse functions (no. 8, $p < .002$), reflection on pupils' linguistic prerequisites in the subject (no. 3, $p < .044$) and learning objectives (no. 1, $p < .008$) showed significant effects in simple regression analyses.

Tab: 4: Regression to learning opportunities with LST-methods

	Regressions to learning opportunities with in-depth exercises					
	AL	AL	LST	LST	LST	LST
Identification of linguistic requirements of content	0.604* (2.17)					
Reflection on expectation of discourse functions		0.578* (2.05)	0.406* (2.17)			
Reflection on the language prerequisites				0.664*** (3.38)		
Presentation of adequate differentiation measures					0.395* (2.37)	
Determination of language objectives in the subject						0.537** (2.87)
constant	3.322*** (5.52)	3.379*** (5.48)	4.652*** (11.34)	3.872*** (9.10)	4.572*** (11.58)	4.427*** (11.77)
observations	122	120	116	131	117	118
R-square	0.038	0.034	0.040	0.081	0.047	0.066
adj. R-square	0.030	0.026	0.031	0.074	0.038	0.058

5 Discussion

As expected, pre-service teachers of language subjects had a better understanding of the concepts of LST and AL (H1). They presumably encounter these topics more often in subject-didactics and subject courses and therefore have a less vague understanding ("that's standard German", "technical terms", "gender language"), even though according to the current Lower Saxony Master's ordinance for teaching qualifications (Nds. GVBl. No. 21/2015 p. 351, § 1), all master's pre-service teachers must be familiar with these topics. This finding is in line with the results of Darsow et al. (2019), who showed that pre-service teachers of German, primary education and, above all, foreign languages had a performance advantage after completing GSL modules. Traditional foreign language may be particularly well suited to LST, as their methodology can be integrated into subject lessons (Leisen 2010). In addition, the subject didactics of German or GSL/GFL have a "serving function" for other subjects and a multiplier effect for the cross-cutting topic in other subject didactics, which in turn adapt LST to subject-specific challenges. Pre-service teachers who perceive that (a) subject teaching can promote language skills and (b) language skills are relevant for subject knowledge acquisition are more likely to report engagement with language-related aspects of instruction, which is associated with a more differentiated understanding of LST and AL (H2).

There were no significant correlations between the statements that subject teaching cannot provide language promotion, that language promotion can slow down subject progression or that subject content should be geared towards language skills. In the descriptive presentation of beliefs about the potential of subject teaching (Fig. 8), the majority of pre-service teachers assumed that language-developing and language-promoting activities do not hinder subject progression and that language promotion can be integrated into subject lessons. More than two thirds of them assumed that subject content should be geared towards language skills and that subject teaching is also language teaching.

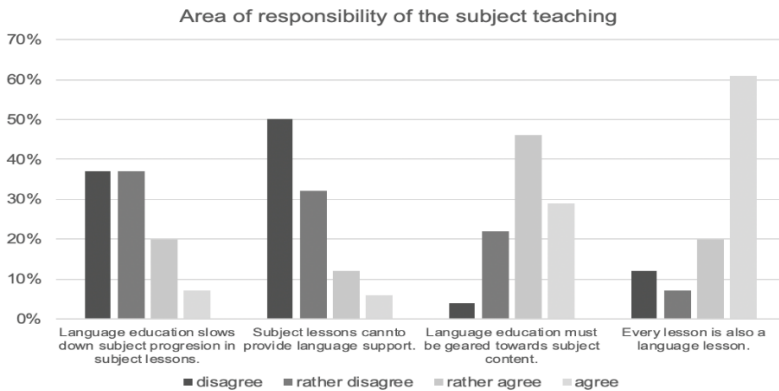


Fig. 8: Responsibilities of subject learning

Interestingly, these beliefs about the role of language in subject teaching showed no significant influence on the understanding of LST or AL (H2). The item "language skills must

be assumed in subject teaching” may be interpreted ambiguously, as it can refer either to general linguistic prerequisites or to the assumption that subject-specific language requirements do not need to be addressed explicitly. The results should therefore be interpreted with caution, particularly for pre-service teachers of non-language subjects. More generally, areas of responsibility are defined within the framework of subject-specific cultures. If pre-service teachers feel responsible for language education and promotion, they should also learn in the context of their subject didactics or subject-specific courses that language and subject learning processes are not separate from one another, and that subject teaching also represents a language acquisition context.

The second principle of *Language Aware Subject Teaching* concerns the transparency of language learning objectives, i.e., language-aware teachers should develop academic language and not take it for granted. They should be aware of the language requirements of their subject lessons.

The results on the inclusion of language learning objectives support **H3**: the more frequently language learning objectives related to subject teaching were reported to be addressed by lecturers in university courses, the more differentiated the pre-service teachers' understanding of LST and AL became, suggesting that these learning opportunities support the development of conceptual understanding. According to the respondents, learning objectives 6, 5 and 1 (Fig. 3) were mentioned most frequently in teaching. These learning objectives can be summarized as two latent factors, discourse and text skills, which have a significant effect on the understanding of both concepts (ALST).

The TEXT factor is based on indicators of writing and reading skill acquisition. The DISCOURSE factor is based on the indicators acquisition of register awareness, acquisition of technical terms and acquisition of subject-specific discourse functions. Text and discourse are central areas of LST support in both oral and written language use. Both aim to guide learners toward subject-appropriate and linguistically appropriate oral and written language activities, which play a decisive role in educational success. In order to follow academic discourse practices in the classroom in an appropriately receptive or productive manner, pre-service teachers need to be aware of register differences, for example between everyday and academic language, including technical terms and their use in the context of subject-specific discourse functions such as describing, arguing, or, in vocational training, orienting in customer discussions. The interrelatedness of these variables is reflected in the structural equation model. The fit indices also indicate that the structural equation model calculated here adequately summarizes the collected data (Hu & Bentler 1999). LST topics and methodical-didactic approaches that can be practiced in in-depth learning opportunities are important for developing pre-service teachers' know-how (**H4**). The results show that scaffolding in particular influences the understanding of LST and AL. Scaffolding appears to be one of the most suitable approaches for systematically incorporating language into subject lessons. Attention can be paid to pupils' language skills, the linguistic requirements of the subject and the classroom discourse as early as the lesson planning stage.

Such in-depth LST learning opportunities are offered less frequently in university teaching. The focus lies predominantly on the language of school students hailing from diverse socio-linguistic backgrounds, with varying levels of linguistic input. Dealing with the language these students bring with them plays a role in all school subjects. In German, differences in register are particularly relevant, as subject-specific concepts are often based on everyday language. Connecting to students' lifeworlds in terms of language and subject matter is part of the 6th principle of LST under Know-How (Tajmel & Hägi-Mead 2017).

6 Further research and Implications for higher education teaching

Pre-service teachers' understanding of the central concepts of LST and AL is related to the range of learning opportunities on the cross-cutting topic of LST in university teaching. The first factors (language studies, beliefs about the language learning potential of subject teaching, inclusion of language learning objectives, frequency of LST topics and methods) were identified. This aligns with findings showing that GSL-related competences can be developed through targeted learning opportunities (Göbel et al. 2023). A limitation of this study is that the data are based on pre-service teachers' self-reports and therefore reflect their perceptions of university teaching rather than directly observed instructional practices. Accordingly, the reported frequency with which language learning objectives were addressed should be interpreted as perceived rather than objectively measured. In addition, despite the anonymous format, socially desirable response tendencies cannot be ruled out. Additional factors may influence the understanding of these concepts. One factor could be the different course offerings in the bachelor's and master's programs, as undergraduate pre-service teachers generally receive fewer language education components than their counterparts at the master's level. The focus of the present study was on master's pre-service teachers, as they are expected to acquire concepts of LST and AL concepts aligned with their subjects. However, potential knowledge gains related to LST or AL across the programs, as well as pre-service teachers' prior knowledge, are not visible in the present data.

A follow-up study will examine the remaining H4 sub-hypotheses regarding prior knowledge and the perceived relevance of GSL-related skills. This will involve examining the four aspects of LST, including hegemonic and linguistic dimensions. Initial evaluations show that the more importance pre-service teachers attribute to language education and language promotion within their discipline, the more important knowledge and skills in this area become.

Since pre-service teachers of language subjects have more prior knowledge, this should be considered when designing learning opportunities at the university. Text and discourse skills play an important role in developing an understanding of LST and AL. School-based discursive functions such as describing or explaining are always subject-specific. Describing a physical phenomenon requires different discourse skills from describing a literary figure. The fact that subject-specific concepts are negotiated through discourse and that linguistic learning objectives must be made transparent must be made clear to strengthen the responsibility for LST in all school subjects. Since university subject cultures influence beliefs

and responsibilities, LST and language learning objectives should be addressed in subject-specific and didactics courses.

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