Christiane Dalton-Puffer*, Silvia Bauer-Marschallinger,
Katharina Brückl-Mackey, Victoria Hofmann, Jennifer Hopf, Lisa
Kröss and Lisa Lechner

Cognitive discourse functions in Austrian CLIL lessons: towards an empirical validation of the CDF Construct

Abstract: It is now widely recognized among educators that explicit attention to language is necessary in order to optimize both language and content learning in situations, such as CLIL, where learners, teachers or both operate in a second language. However, the requirement of attention to language sits uneasily with the fact that content-subject specialist teachers frequently feel unprepared to think and operate in linguistic dimensions. In an attempt to create a conceptualisation that would speak to subject teachers in terms that are meaningful to them from within their own subjects, a Construct of Cognitive Discourse Functions (henceforth CDFs) has been proposed. This construct is theoretically founded in both educational curriculum theory and linguistic pragmatics and consists of a seven-fold categorization of verbalizations which express acts of thinking about subject matter in the classroom (CLASSIFY, DEFINE, DESCRIBE, EVALUATE, EXPLAIN, EXPLORE, REPORT). As the theoretical background of the CDF Construct has been discussed at length elsewhere (Dalton-Puffer 2013, 2016), it will be presented only briefly at the outset of this article. The main purpose of this contribution is to report on steps taken towards an empirical validation of the CDF Construct. A total of four smaller-scale studies each focusing on the classroom discourse in one subject (biology, physics, economics, history) will be surveyed in order to find answers to the questions of whether CDFs actually occur in class-

---

*Corresponding author: Dr. Christiane Dalton-Puffer, University of Vienna, English Department, Spitalgasse 2-4/Hof 8.3, 1090 Vienna, Austria, E-Mail: christiane.dalton-puffer@univie.ac.at
Silvia Bauer-Marschallinger, University of Vienna, Vienna, Austria,
E-Mail: silvia.bauer-marschallinger@univie.ac.at
Katharina Brückl-Mackey, University of Vienna, Vienna, Austria, E-Mail: rkmackey15@gmail.com
Victoria Hofmann, AHS Rahlgasse, Vienna, Austria, E-Mail: victoria.hofmann@ahs-rahlgasse.at
Jennifer Hopf, Parhamer Gymnasium, Vienna, Austria, E-Mail: jennifer.hopf@gmx.net
Lisa Kröss, GRG Franklinstraße 26, Vienna, Austria, E-Mail: kroess.lisa@grg21f26.at
Lisa Lechner, HTL Krems, Krems, Austria, E-Mail: lisa.lechner91@gmx.at

room interaction and if they do, which and to what extent. Comparisons to a small complementary study on a set of EFL lessons will be made where appropriate. Results show that CDFs are indeed a staple of teaching and learning in classroom-based education but are in no way equally distributed. Also, they are almost never the object of conscious attention. As a number of further questions remain yet to be answered on the way towards empirical validation of a fully articulated CDF Construct, these will be discussed in the conclusion of the article.

Keywords: cognitive discourse functions, CLIL, integrated pedagogy, academic language, classroom discourse

1 Introduction

Today's competence-oriented principles in education mean that students should not only be equipped with knowledge but should be enabled to do something with what they have learned. As this 'doing' consists to a considerable degree of 'languaging', applied linguists have long argued that functional dimensions of language ought to be a centre-piece of competence-oriented pedagogy. We therefore consider all theoretical and conceptual groundwork presented in this article to be relevant to classroom teaching in general no matter what the medium of instruction happens to be, a first or a second, a majority or a minority language. However, in the real world of school education urgency and problematicity are not experienced at equal levels across the board. An educational context where the pivotal role of language for classroom learning is usually accepted by educators of <u>all</u> subjects, at least in principle, is Content-and-Language-Integrated Learning (CLIL) as all learning activities proceed in a language that is neither the learners' nor usually the teachers' main language or L1. An analogous situation for learners, though less readily recognized by classroom teachers, holds for immigrant learners being schooled in their L2.[1]

It has, therefore, been an important concern in CLIL research to develop conceptualisations of content-and-language integration which ensure a balanced pedagogy (e.g. Coyle 2007; Meyer 2010), as well as to grasp the multidimensionality of 'integration' (Nikula et al. 2016). Despite significant progress in this respect, developing an understanding of 'integration' that is sufficiently fine-

---

1 Some CLIL researchers might not be aware of these similarities, but applied linguists focusing on immigrant learners are (e.g. Ahrenholz 2010; Schmölzer-Eibinger 2013). Neither are all first language speakers of the medium of instruction equally well equipped for the challenges of working through and working with curricular content in oral and written language.

grained to be meaningful on the level of classroom pedagogy as well as substantially linked to both language education and specific frames of reference of history, science, or arts education continues to be a challenge. Such an understanding, though, is essential as approaches to language-aware subject teaching that are exclusively anchored in the world of linguistics and language education are in danger of being experienced as transgressive or even meaningless by content-subject educators.

One level of language which functional linguists have repeatedly recognized as offering high transdisciplinary potential are academic language functions or cognitive discourse functions (e.g. Mohan 1986; Schleppegrell 2004; Thürmann and Vollmer 2013; Zydatiß 2010). These are discursive, lexical and grammatical schemata arising from the routines of working with and towards specialist knowledge and which form an integral part of spoken and written subject literacy. For reasons explained elsewhere (Dalton-Puffer 2013) we will refer to them as Cognitive Discourse Functions (CDFs) in this paper. Individual CDFs (above all explaining, describing, defining, and hypothesizing) have been the object of earlier studies (e.g. Kidd 1996). In the context of CLIL, Dalton-Puffer (2007a) and Lose (2007) describe and analyse the use of several of these functions in classrooms in Austria and Germany, while Llinares and Morton (2010) do the same for historical explaining in Spanish CLIL lessons. Insightful though they are, these earlier studies could not refer their observations to a comprehensive account of CDFs per se, but remained focused on individual functions.

A fully articulated and theoretically coherent account of CDFs has become available through Dalton-Puffer's CDF Construct (2013, 2016) which we will briefly introduce in Section 2 of this article. The intention behind the CDF Construct is, on the one hand, to provide a conceptualization for language and content integration that is meaningful not only to language educators but also to educators who are specialists in so-called content-subjects and, on the other hand, to serve as a heuristic tool in analyzing language demands in teaching materials, examination tasks as well as naturalistic classroom discourse. So far, however, the CDF Construct has been introduced only in theoretical terms, while links with actual situations of use in real classrooms have been established only via illustrative examples. The main aim of this article is therefore to provide evidence, for the CDF Construct as a whole in naturalistic CLIL classroom discourse, thereby contributing to the necessary empirical validation of the construct. For this purpose we will summarize the findings of five individual studies that applied the CDF Construct in the analysis of lessons from five school subjects.

2 The Construct of Cognitive Discourse Functions

The CDF Construct proposed by Dalton-Puffer (2013) rests on the two premises that a) the conscious cognitions about the world dealt with in formal education are fundamentally structured by language, i.e. that language is how (new) meanings about the world make their way into learners' minds, and that b) language is the main way in which learners can share their current or new construals of the world with others. In concrete terms, this means that teacher and student classroom talk, written work, textbooks, exam questions/answers are structured by the demands arising from working towards the curricular goals. In today's competence-based curricula, these curricular goals are couched in can-do statements pivoting around performative verbs, as is illustrated below with extracts from current Austrian subject curricula.

> Students can *identify* goal-conflicts in economic policy and are able to *formulate different positions*. (Geography, Austria)[2]
> History education shall enable students to *critically analyse* social, cultural, economic and political structures and processes. (history, Austria)[3]

Extract 1. Examples from current Austrian subject curricula [translated by the authors]

From the point of view of linguistic theory, the performative nature of these subject-specific competence formulations makes them something like Speech Acts: a definition arises by being formulated in language, a categorization is expressed by being put into words, an analysis is evidenced by being communicated in language. The CDF Construct, then, proposes to bundle the multiplicity of labels for the linguistic acts that are to be performed in fulfilment of curricular demands into seven basal categories, called CDF types. Each type is based on an underlying communicative intention (i.e. a type of Speech Act) which is realized as teachers/learners *identify, formulate different positions, describe, analyse, explain, compare, specify, hypothesize, recount* etc. in the process of teaching, learning, and examining. Table 1 shows the construct.

---

2 Source: Austrian Ministry of Education Curriculum for Upper Secondary Academic Schools; https://www.bmb.gv.at/schulen/unterricht/lp/lp_neu_ahs_06_11858.pdf?61ebyi. [Our translation].
3 Source: Austrian Ministry of Education Curriculum for Upper Secondary Academic Schools; https://www.bmb.gv.at/schulen/unterricht/lp/lp_neu_ahs_05_11857.pdf?61ebyg. [Our translation].

Table 1: The Cognitive Discourse Function Construct

underlying basic communicative intention	CDF TYPE	performative verbs
I tell you how we can cut up the world according to certain ideas	CLASSIFY	*classify, compare, contrast, match, structure, categorize, subsume*
I tell you about the extension of this object of specialist knowledge	DEFINE	*define, identify, characterize*
I tell you details of what I can see (also metaphorically)	DESCRIBE	*describe, label, identify, name, specify*
I tell you what my position is vis a vis X	EVALUATE	*evaluate, judge, argue, justify, take a stance, critique, comment, reflect*
I tell you about the causes or motives of X	EXPLAIN	*explain, reason, express cause/effect, draw conclusions, deduce*
I tell you something that is potential (i.e. non-factual)	EXPLORE	*explore, hypothesize, speculate, predict, guess, estimate, simulate*
I tell you something external to our immediate context on which I have a legitimate knowledge claim	REPORT	*report, inform, recount, narrate , present, summarize, relate*

For reasons of space we do not provide examples of CDF realizations here. An illustration of a short passage featuring several CDFs is provided by Extract 2 (Section 3).

The principles of the CDF Construct can be summarized as follows: the construct captures verbalizations linked to cognitive processes that are routinely performed in the course of dealing with curricular content while working towards curricular goals in formal education. As these cognitive processes are not directly observable, verbalisations are taken to be the only accessible analogues of thought. In the context of the learning group characteristic of formal education, such verbalizations of thought often are not simply reflections of individual thought-processes but are acts of communication at the same time. They are, in fact, the backbone of knowledge construction within the learning group (cf., for example, Mercer 2000). Subscribing to a social theory of learning, the CDF Construct therefore foregrounds the communicative intention of discourse partici-pants in the teaching/learning event as they work towards cognitive and perfor-mative goals encapsulated in subject curricula. The theoretical roots of the CDF Construct, therefore, lie in functional pragmatics (e.g. Ehlich and Rehbein 1986) and Systemic Functional Linguistics (e.g. Halliday 1993, 1994; Christie 2002).

As the CDF Construct has so far been linked to actual teaching and learning activities in CLIL classrooms mainly via illustrative examples (Dalton-Puffer

2016), this contribution now takes a further step on the path towards the empirical validation of the construct and reports on a series of quantitative and qualitative analyses of classroom discourse unfolding among teachers and learner as participants in secondary school lessons. The following research questions will be the focus of our summary of five individual studies:

1. How much evidence of CDFs is there in naturalistic CLIL classroom discourse?
2. How much evidence is there of particular CDFs?
3. Who performs CDFs in classroom interaction?
4. Are CDFs given explicit attention? Is there meta-communication on CDFs?
5. How are CDFs performed interactionally and linguistically?

In the present report we will foreground the quantitative aspects of the findings (research questions 1–4) and will present some limited material to illustrate findings regarding research question 5.

3 Research context and description of the studies summarized

The studies presented in this article have all been carried out as stand-alone MA-thesis projects in pursuit of a degree for qualified secondary school teacher status in Austria, under the supervision of the lead author. Since all Austrian secondary teachers qualify in two school subjects, all of the other authors had also studied another school subject and so, with one exception, they all carried out their research on CLIL classrooms where their content-subject (history, physics, business and economics, biology) was taught in English. The one exception is the study on CLIL physics by Kröss, who is an English/mathematics graduate. Table 2 gives an overview of the studies reported in this article.

Table 2: Data Overview.

study	author	subject	corpus size (50-min lessons)	grade level	school type/teachers
1	Kröss 2014	physics	6	9,10,11	academic; 3 Ts; NS assistant in 2 lessons

Table 2: (continued)

study	author	subject	corpus size (50-min lessons)	grade level	school type/teachers
2	Hofmann and Hopf 2015	biology	8*	9, 12	academic; 2 Ts
3	Brückl 2016	business & economics	6	10, 11, 11	vocational; 3 Ts + NS assistant in 2 lessons
4	Bauer-Marschallinger 2016	history	8*	7,10	academic; 2 Ts + NS language assistant every second lesson; only student lg. analysed
5	Lechner 2016	English as a foreign lg.	8	10,11,12,13	academic and vocational; 2 Ts

(*2 complete didactic units à 4 lessons)

The data-base used in the individual studies consisted of transcripts of audio or video-taped CLIL lessons that were either part of the supervisor's database of CLIL lessons (business & economics, physics[4]) or were collected by the researchers themselves (biology, history, EFL). All schools involved in the five studies lead their students to university entrance qualifications, some have a vocational, some a general academic focus. As is clearly visible, upper secondary lessons dominate the overall corpus. Unless whole didactic units were recorded (biology, history) two lessons per learning group were included in the corpus. All class teachers were Austrian with German as their L1. As the Austrian school authorities do not require formal certification of language competence level from CLIL teachers, teachers' competence in English ranged from near-native (most of those with EFL as their other subject) to B2+. As indicated in Table 2 above, some teachers were assisted some of the time by native English-speaking teaching assistants. These language assistants do not hold a formal teaching qualification, their role being to serve as language support regarding pronunciation, spelling, vocabulary, syntax, and stylistic matters.

---

4 Dalton-Puffer thanks Markus Schrönkhammer for letting her add his CLIL physics video-corpus to her department's database (Schrönkhammer 2012). Part of this corpus was transcribed and analysed by Kröss (2014).

The most frequent home language among the student body was German, but a wide range of other home languages were also present (Serbian-Croatian-Bosnian, Albanian, Turkish, Russian, Polish, Romanian, English and others). Students started to be exposed to some English FL teaching at primary grade 1, moving on to systematic EFL lessons upon entrance to secondary school at grade 5, with weekly exposure diminishing from 5 to 4 to 3 EFL lessons as students move to higher grade levels. At grade level 12/13 students are expected to have reached level B2 of the CEFR.

At the times of data collection, there were no binding regulations regarding the provision of CLIL within the Austrian school system, so that the way in which CLIL was offered in terms of when, how much and in which subject(s) varied from school to school. Since then, the vocational upper secondary system has introduced compulsory CLIL for 72 hours per year, but in general, CLIL provision in Austria is either governed by school-specific policies or simply by the contingencies of teacher availability and student/parent demand.

The recorded lessons were transcribed (or existing transcripts revised) and were then coded according to the seven basal categories laid out by the CDF Construct. Coding proceeded by matching strings of participant talk with the underlying communicative intention of one of the seven CDF types. This means that the realisation of a CDF is not automatically coextensive with a turn-at-talk. It can be, but can also be less than a full turn or it can extend over several turns and involve more than one speaker (see section 4.4). Except for study 4, which looked only at students' utterances, both teacher and student language was coded. The full coding schemes of individual studies were further elaborated to capture subcategories of the main CDF types (e.g. EVALUATE (*difficulty, certainty, importance*) *(+/- justification*) in Hofmann and Hopf 2015), the reporting in this article will, however, focus on the main category, or Basic Level, "CDF type" which is identical in all the studies.

Apart from the realization of single CDFs, CDFs can also group together into episodes, since classroom interaction sometimes features longer stretches that clearly serve an overall communicative function but include other CDFs. Extract 2 provides an example of this two-level organization. The passage as a whole has been categorized as REPORT, its function in the lesson being to frame the in-depth treatment of a new topic, that is magnetism. Several other CDFs are embedded into this narrative. We also use this example to illustrate the more fine-grained level of CDF subcategories referred to in the previous paragraph.

Extract 2. Example of a passage coded at Basic Level and Episode Level "Knowledge of electricity and magnetism in the past". Some more fine-grained distinctions below Basic Level have been added in italics.

		Episode: REPORT	BASIC LEVEL	EPISODE LEVEL
01	T:	yeah? so we've known about electric effects? for at LEAST about three thousand years now? [door opens, a student walks to his place] okay. so for instance EVEN EVEN as long as a three thousand years ago? they knew that if you RUBBED a stone? such as amber?	REPORT	REPORT episode
		you know (what) amber is in German?	DEFINE *translate*	
02	S3:	<L1de> Bernstein.= </L1de>		
03	T:	=yesss. so if you rub a stone like amber? that it would demonstrate uhm specific electric effects.	EXPLAIN *cause/effect*	
		yah? so this is even three thousand years ago. yah? and uhm even TWO thousand years ago? Chinese sailors knew about magnetic forces. Yah [smiles] using the uh MAGNETITE STONE. they real- the already knew about magnetic forces	REPORT	
		yeah? and why would sailors need magnetic forces? or how would they USE magnetic forces?	EXPLAIN *reasoning*	
03	S4:	to know where they are?=		
04	T:	=know where they are?		
05	S4:	<2> where </2> north is? and all that?=		
06	T:	=using what?		
07	S4:	a compass?=		
08	T:	=using a compass. exactly. so we've been using compasses to tell where we ARE? using MAGNETIC properties for a REALLY long time? already? yah? so you use compass needles for navigation? to tell you WHERE you're going? and which diRECtion that you wanna go to. yah? which direction you wanna go IN.	DEFINE *functional*	
		so EVEN though THOUSANDS AND THOUSANDS of years ago we knew about electric forces with stones like amber? [points at slide] and we knew about magNETic forces with stones like magnetite? we didn't we couldn't really EXPLAIN it. that long ago. we weren't advanced enough to explain WHY HOW things happened. we just knew that they HAppened yah? that we COULD use magnetic forces to get ourselves from place to place. you know as sailors.	REPORT	

As indicated above, the quantitative account in the present article rests on Basic Level of analysis, categorizing and counting individual CDF realisations irrespective whether they stand alone or are part of a longer episode. CDF episodes are not part of the counts presented in the results section.

Before analysing the classroom data, the researchers also performed an analysis of the curriculum of 'their' subject, seeking to link subject-specific learning goals with the performance of CDFs. Such overlaps were indeed in evidence but since the subject-specific pedagogical cultures as well as the histories of individual curricula vary to a considerable extent, the results of these analyses are impossible to summarize in a short section and will be referred to only briefly in this article.

4 Findings and discussion

This section will report on aggregated findings across studies, arranged under the headings of the research questions presented in the introduction. In the interest of readability, the discussion of individual results is included under the individual headings rather than gathered in one larger section at the end.

We would like to start the presentation of findings with a cautionary remark: as the following tables and diagrams tend to prompt a degree of reification that is not always warranted, we point out that all results reported here are necessarily preliminary and limited. It is clear that individual teachers and their pedagogical styles and preferred classroom activity types have an impact on how (many) CDFs are performed in their classrooms and by whom. Across all five studies, this factor might possibly be levelled out, as 12 different teachers contributed to the aggregate dataset. But also the nature of the subject taught must be assumed to influence the prevalence (or lack of) certain CDFs. For instance, Brückl (2016) found that the economics curriculum greatly emphasizes the competences of classifying, evaluating and reporting. However, as each subject is represented by only 2–3 teachers, it is impossible to keep the factors teaching style and impact of subject separate. Moreover, the emphases of the curriculum are not necessarily mirrored in what transpires during actual lessons, which is evidenced by Brückl's findings where, of the competences emphasized by the curriculum, only REPORT can be observed in the data with some regularity.

The rest of this section will be structured according to the research questions formulated at the end of Section 2.

4.1 How much evidence of CDFs is there in naturalistic CLIL classroom discourse?

The question of whether CDFs are identifiable in naturalistic classroom discourse at all is of course fundamental to the empirical validation of the CDF Construct.

The figures across studies rendered in Table 3 provide strong evidence that CDFs are indeed a regular component of classroom interaction at school level; in total, more than 2300 occurrences of CDFs were observed across 36 CLIL and EFL lessons.

Table 3: Overall occurrence of CDFs across studies

study/subject	1 physics	2 biology	3 econ	4 history	5 EFL
lessons	6	8	6	8	8
total CDFs	504	619	480	265 (SS only)	481
CDFs/lesson	84	77	80	33 (SS only)	60

The bottom line of Table 3 shows a substantial number of CDFs are performed in every lesson on average and given that the standard length of lessons is usually a few minutes short of the nominal 50 minutes, it is a conservative estimate to say that 1.5 CDFs are performed every minute if teacher and student utterances are taken together (studies 1–3). The numbers in study 4 diverge since only student utterances were coded in this particular study. However, numbers in study 4 are also a-typical because the strongly student-centred character of the lessons in this particular data-set leads to above-average numbers of CDFs performed by students (see Section 4.3 below). CDF frequency in the English as a Foreign Language lessons is somewhat lower than in the CLIL lessons (1.2 CDFs per minute).

4.2 How much evidence is there of particular CDFs?

In all of the five studies, evidence has been found for each of the seven CDF types, but not with an equal degree of frequency. If we take one of the studies as an illustrative example (Hofmann and Hopf 2015), we see that during two didactic units on genetics and transport across membranes, verbalizations of some content-directed thought processes were performed much more often than others. The pie chart in Figure 1 shows the share of individual CDFs as percentages of the total number of CDFs performed.
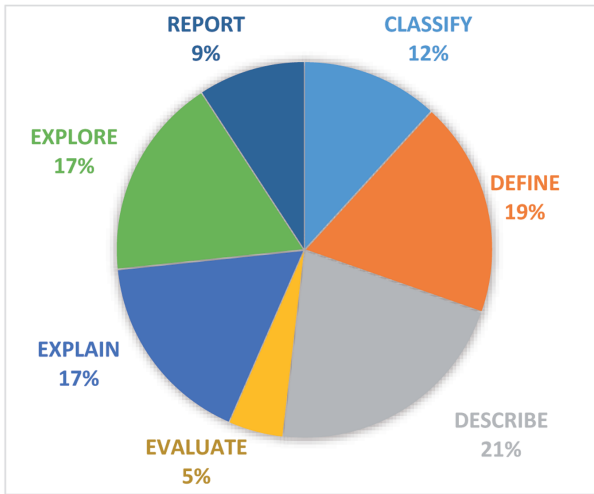
Figure 1: Distribution of CDFs in 8 biology lessons (N=619; Hofmann and Hopf 2015: 82)

As one can easily see, CDFs are not all used to the same extent in these biology lessons, their individual share ranges from 5-21 % (which would be 29–133 in absolute numbers). Evidently, activities involving DESCRIBE, DEFINE, EXPLAIN or EXPLORE are carried out quite often and to a more or less equal extent, while others hardly occur at all (EVALUATE). That such a relatively even share of several CDFs in classroom talk is not necessarily typical of all studies, can be appreciated if we convert the pie-chart of Figure 1 into a table and add the corresponding figures from the other four studies (Table 4).

Table 4: Share of individual CDFs as percentages per subjects

CDF	1 physics	2 biology	3 econ	4 history	5 EFL
classify	0.6 %	12 %	4.4 %	11 %	11 %
define	15 %	19 %	18 %	17 %	20 %
describe	**35 %**	**21 %**	12.5 %	**29 %**	**32 %**
evaluate	0.2 %	5 %	12.5 %	13 %	12 %
explain	20 %	17 %	18.5 %	21 %	14 %
explore	15 %	17 %	9 %	2 %	3 %
report	14 %	9 %	**25 %**	7 %	8 %

To make the table more easily readable, the highest percentage has been formatted bold in each column, showing that the most frequent CDF overall is

DESCRIBE, and commonly by a wider margin than in the biology data. In fact, the only data-set that behaves differently is business & economics (econ), as REPORT in the shape of students' project presentations plays a very important role in this particular dataset. As indicated above, Brückl's (2016) curriculum analysis found that the economics curriculum does indeed emphasize competences expressed through REPORT. However, the curriculum also emphasizes CLASSIFY and EVAL-UATE, but these competences are not mirrored in the actual lessons to the same degree. Analogous observations have been made by Bauer-Marschallinger (2016) whose curriculum analysis showed a broad spread of CDFs across the historical competences stipulated by the curriculum, which were, however, not realized to the same extent in her classroom data.

In order to enhance the visibility of the differences and similarities across subjects, the following table (Table 5) displays CDFs colour-coded and in order of frequency for each data-set.

Table 5: Frequency ranking of CDFs per subject/data-set

1 physics	2 biology	3 econ	4 history	5 EFL
Describe	Describe	Report	Describe	Describe
Explain	Define	Explain	Explain	Define
Define	Explore	Define	Define	Explain
Explore	Explain	Describe	Evaluate	Evaluate
Report	Classify	Evaluate	Classify	Classify
Classify	Report	Explore	Report	Report
Evaluate	Evaluate	Classify	Explore	Explore

Quite clearly, the CDFs which emerge as the most frequently used ones across subjects are DESCRIBE, EXPLAIN and DEFINE, with business & economics appearing to be an exception, at least for the dataset analysed. In fact, DESCRIBE almost seems to be a defining characteristic of the communicative setting of the 'lesson'. During the lesson it is necessary for teachers and students alike to share their perceptions of the various objects of learning in order to establish an intersubjectively validated 'state of affairs' ("this is what we see, this is what X is like") which can then serve as the basis for further work. This, we would argue, is a fundamental characteristic of classroom discourse as such (cf. e.g. Mercer 2000) and would seem to be the case independent of whether transactions are happening in L1 or L2. The high rank of the function DEFINE, one the other hand, may well be more specific to CLIL and EFL rather than to classroom teaching in general, as it may be due to the fact that coding subsumed under DEFINE

included not only technical definitions in the narrow sense but all instances where the meanings of words in one language were linked to the meanings of words in another language. There is a strong tendency for teachers to carry out such clarification of new lexemes in the form of definitions in the target language (e.g. "the kidney is an organ that purifies the liquids inside your body") and a very strong tendency for students to react to a clarification request with a straight translation of the respective word to the L1. Viewing Table 5 also invites speculation as to whether the nature of the individual subjects might not have an impact on the frequency of certain CDFs. The findings regarding EVALUATE displayed in Table 5 above certainly seem to corroborate the stereotype that social science and humanities subjects provide more space for students to position themselves vis-à-vis the content than natural science subjects. We have already expressed our caution as to the generalizability of our findings at the start of the results section and would like to underscore this by adding that the nature of the topic as well as the stage of a particular didactic unit which is included in the database may significantly impact on findings regarding CDFs. Hofmann and Hopf (2015) (study 2) have made the details of these dynamics visible in Figure 2 as follows. Lessons A1-A4 are on Mendel genetics, lessons B1-B4 are on transport across membranes.
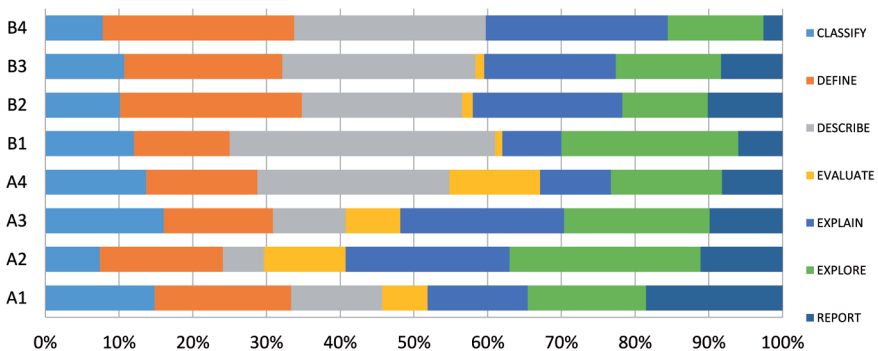

Figure 2: Distribution of CDFs over two didactic units in biology (Hofmann and Hopf 2015: 83)

Once we visualize the didactic units separately (A1–4 vs. B1–4), it becomes evident that maybe certain topics are more conducive to speculation and hypothesising than others (cf. the higher incidence of EXPLORE in lesson A1-A4 on Mendel genetics). Given the structure of the data-set, this effect could, however, also be due to two different teachers being involved in the two didactic units. These clearly are questions that need to be explored via a larger number of observations across more teachers and topics from one particular subject.

4.3 Who performs CDFs in classroom interaction?

An important question with regard to the teaching and learning activities ob-served in the data is of course not only which CDFs occur and how often, but also who performs them. How much of the verbalization of content-directed thought is realized by the teacher, how much by the students and how much is constructed dialogically between teachers and students as they work towards the respective learning goals? The analysis on this level gives insight into the degree of learner-centredness built into the pedagogical designs that are realized in the lessons which make up the overall data-set and thus depend on a mix of individual teacher style and subject-specific didactic traditions. Table 6 shows the percen-tages of CDFs realized by teachers and students individually or dialogically. In the EFL data, textual sources for CDFs are an integral part of the unfolding lesson. The history data are absent from the comparison in Table 6, as only student-utterances were analysed in that study.

Table 6: Realization of CDFs over teachers, students and teacher-student dialogue

	teacher	student	T & S	materials
1 physics	35	6	59	-
2 biology	67	7	26	-
3 econ	45	37	18	-
5 EFL	18	59	-	23

The EFL figures lack the dialogic category, as the count in this particular study (Lechner 2016) was based on who initiated a CDF and not whether it continued monologically or dialogically. Given this fact, both the teachers' 18 % as well as the students' 59 % would likely turn out somewhat lower if one extracted dialogic realizations into a separate category. Even so, the EFL column indicates that this data set consists of strongly student-centred language lessons in compliance with the national curriculum's stipulations that strongly prioritize Communicative Competence as the goal of foreign language education.

Zooming in on the econ-figures (Brückl 2016), one can see that considerable variation is hidden behind overall percentages. Table 7 gives insight into the distribution of CDF realization in the lessons of three different econ teachers:

Table 7: Distribution of CDFs in business & economics across realizers and teachers (Lechner 2016: 77)

realizer	econ teacher A	econ teacher B	econ teacher C	econ TOTAL %
T	54 %	33 %	40 %	**45 %**
S	30 %	46 %	42 %	**37 %**
TS	15 %	21 %	18 %	**18 %**

The percentage figures in columns 2 and 3 show that the interactional practices of teacher A and teacher B with regard to speaking rights are practically mirror images of each other, with teacher C placed somewhere in between. Brückl (2016) also carried out a separate analysis according to whether CDFs were performed in English (L2) or German (L1). Her findings show that the distribution is consistent for individuals irrespective of the language they are using. This further indicates that individual teaching style is a strong factor in how CDF speaking roles are distributed out in classroom interaction. This close-up of econ-lessons demonstrates that individual teaching style and presumably the pedagogical design chosen for the treatment of specific topics have a great impact on who performs CDFs actively during lessons.

Despite the internal variability in the data and the overall data-set therefore being far too small for statistically valid generalizations, certain tendencies emerge in Table 6 that do seem to corroborate preconceptions about the typical pedagogies of certain groups of school subjects: social science and humanities subjects appear to be more open to giving students voice in classroom proceedings than the natural science subjects, especially when looking at student-only CDF realizations. On the level of language learning this would imply that traditionally more strongly teacher-centred classroom proceedings, as observed in the natural sciences, provide students with far fewer opportunities to realize CDFs autonomously and thus with fewer learning opportunities in this respect.

4.4 Is there a meta-level?

Many instances across the corpus demonstrate (and some illustrations will be given in 4.5) that teachers' classroom language shows competent subject-specific language use, in other words, teachers function as models of subject-appropriate oral interaction. The question which arises, then, is whether, this modelling function is brought to the attention of students. Do teachers ever mention CDFs, do they raise their students' awareness of CDFs or do they even explicitly teach

them? In other words, is there meta-talk in this respect? Our definition of meta-talk is in line with Lemke's "Metadiscourse is talk about talk" (1990: 118).

Of the studies summarized in this article, studies 1, 2 and 5 included an explicit level of analysis directed at meta-talk, so our report will be based on only three studies with regard to this question. All instances of meta-talk found are uttered by teachers, and in 68 (of 74) instances this meta-talk amounts to the use of a performative verb referring to CDFs such as *classify, define, describe, explore, explain, label* and some nominal derivatives (*explanation*).

Table 8: Instances of meta-talk

CDF	1 physics	2 biology	5 EFL
classify	0	5	0
define	9	14	1
describe	3	1	0
evaluate	0	0	0
explain	18	14	0
explore	4	5	0
report	0	0	0
Total	34	39	1

Here are some examples of biology and physics teachers using CDF verbs in their classroom talk:

Extract 3a.-3d. Meta-talk. Examples of performative CDF verbs in the data.

> 3a.T: **And I'm to now label them** a little bit so that you understand what the parts are called. (CLASSIFY)
> 3b.Yes but could you **explain** it in English, maybe?
> 3c. You can use c, yes but you have to **define** it.
> 3d. and there's waves coming to the opening **what can you explain wha- what happens then**

Instances where the teacher announces to the learners what type of verbal-cognitive action s/he is going to perform, has been termed pre-emptive meta-talk by Basturkmen, Loewen and Ellis (2002: 11). An example of reactive meta-talk identified by Hofmann and Hopf (2015) demonstrates that this type, too, seems intended to draw students' attention to the verbal-cognitive action that is being performed, with reactive talk focusing on critique.

Extract 4. Meta-talk. Reactive use of performative word *definition* (biology)

> Sf: Uhm, it's a condition that's, uhm, more common for a certain sex {because...}
> T: {Uhm, it is more common} like for example in males; that is, well this is correct; **it is... strictly speaking, uhm, not the cleanest definition.**

Another example of reactive meta-talk has been identified in the EFL data-set (where it is the *only* instance of meta-talk altogether):

Extract 5. Reactive meta-talk in EFL (study 5)

> S: Ah, developed countries are countries where the- where the, ah, where the, where the environment where, ah, where they are, ah, entwickelt [developed], Frau Professor, wos hastn entwickelt [how do you say 'developed'].
> T: Ja, developed.
> S: Ah, ah, high developed.
> T: Well, you can't really explain the word by using the word. This, ah, will lead you into trouble.

Extract 5 also illustrates another phenomenon, namely that quite often, teachers' uses of such performative verbs/nouns will activate the general, non-technical semantic potential of these lexemes with *explain* particularly affected. This has prompted Dalton-Puffer (2016) to distinguish between *explain*-1 and *explain*-2,3 to capture the general (1) vs. technical (2,3) guises of the word.[5] In fact, *explain*-1 "seems to be used like a hypernym for other cognitive discourse verbs, and acts as a dummy CDF as it were" (Dalton-Puffer 2016: 37). This is illustrated by Extract 6.

Extract 6. Meta-talk. Non-technical use of *explain* (biology, study 2)

> T: and this is a new term which I did not **explain** yet [...] okay, and a mono-hybrid cross is a cross where we consider only one characteristic for example like flower-colour.

In this passage, the teacher is introducing the new term *mono-hybrid*, telling the students that s/he will explain it while really what s/he does is provide a formal definition. Frequently, e*xplain* also acts as a stand-in for DESCRIBE (see example 7d), but *describe* is also used when EXPLAIN is meant (Kröss 2014).

We have seen across data-sets that there is some, but by no means frequent, reference to CDF-related notions via the use of performative verbs or nouns and thus some micro-attention to CDFs via pre-emptive and reactive meta-talk. What

---

5 The technical meanings of *explain* (2,3) refer to motives (2) and to causation in the narrow sense (3).

we have, however, not been able to observe across the five studies reported on here, is something that might be understood as 'teaching (about) CDFs'. It is therefore fair to characterize our corpus of Austrian CLIL lessons as showing low levels of explicit communication on CDFs. This is in line with Lemke's observation that "[t]he thematics of a subject tends to be taught as if all the teacher had to do was *say* it, not tell *how* to say it" (Lemke 1990: 118).

4.5 How are CDFs performed interactionally and linguistically?

The present article, or indeed any single journal article, cannot accommodate a comprehensive analysis of the linguistic resources in use for the realization of various CDF types. The only intention of the present section is therefore to provide some illustrative examples from the corpus which delivered the largely quantitative results reported in the other sections.

Our first illustration shows how the same CDF is performed monologically by the teacher, monologically by a student, and interactively. The example comes from one lesson in the business & economics data-set and the CDF in question is DEFINE.

Extracts 7.1–7.3. Definitions from business & economics

> **7.1** Teacher: a **high involvement decision** is a decision where a lot of money or a lot of time is necessary to just say yes or no
> **7.2** Student: **mobile parenting** is when erm the parents can control their kids even if they are not with them so when parents are in work they phone them and they know what children are doing and
> **7.3** Dialogic: **phases in the product cycle**
> T: an introduction phase. what is going on in the introduction phase? (.) **what is it?**S: well you make erm <un>xxx</un> vermarkten [to market] you make a <un>xxx</un> for a product i think.T: it is the stage where a new product is launched on to the market (.) you have to market it (.) you have to make advertising (.) you have to <un>xxx</un>=

Definition 7.1 shows the teacher modelling a canonical definition, complete with a definiendum + superordinate term + specifying descriptors packaged into a relative clause (cf. Trimble 1985; Snow 1987). The specimen in 7.2 is formally less complete as it is missing the superordinate category, but still, we would argue, interactionally effective. More typical of student realizations of DEFINE, however, are exchanges like the one in 7.3 where a student makes a truncated contribution, with part of the material (*vermarkten*/*to market*) being taken up by the teacher in her dialogic reformulation. A more strongly collaboratively constructed definition can be illustrated with the following example from history.

Extract 8. Collaborative definition of **pilgrim** (history; data from Dalton-Puffer 2007b)

T: so .. er .. the who were the pilgrims. you could also use that. Victoria who were the pilgrims
S1: the early settlers
S2: the early settlers
T: Yeah okay
S3: woa bist du gut [wow, aren't you clever]
T: so anything else that you could add which makes sense as far as the
S4: =the pilgrims=
T: =settlers are concerned=
S4: =were persecuted because of their religion
T: Good. persecuted because of their religion yes

The answers given by S1 and S2 provide the superordinate category, upon which the teacher turns to eliciting descriptors. She gets one from S4 ("the pilgrims were persecuted because of their religion") and echoes the verb-phrase in her positive evaluation of S4's contribution. After this, no further descriptors are sought for and the talk moves on. A coherent definition of the term *pilgrim* has not been uttered in the event, although it is evident from the overall dataset that this and all other teachers are capable of formulating and modelling canonical definitions. They do this particularly often when students request the clarification of a technical term or some other unknown vocabulary item, sometimes adding a translation into the common language (here German) as an afterthought (or perhaps as a reaction to non-verbal signals of non-understanding). Students, on the other hand, routinely react to an analogous request by giving a straight translation.

Our observations regarding realizations of EXPLORE show that students signal the function mainly via adding the markers *maybe* or *I think*, while there seems to be a tendency to avoid the use of modal auxiliaries even though these have long been covered in the foreign language curriculum and are modelled by the teacher in the elicitation and in recasts as in Extract 9.

Extract 9. Business & economics grade 11

1 T: **if you had**.. two million of euro ... you could either put it on the bank ...
2 S: dann wär ich scho lang (nimmer da)[in that case I'd have disappeared from here ages ago]
3 T: **could you do** anything else with your money?
4 Sm1: yes, I **can** buy shares.
5 Sm2: in[w]est it
6 T: **you can** invest it, **you could** buy shares, ya
7 Sm3: **you can** buy a new house and a (xxx)

8 S: Immobilien (xxx) [real estate]
9 Sm1:   or .. **I can became** a silent partner.
10 T: I can become
11 Sm1:   become, yes, I'm terribly sorry
12 T: **you could become** a silent partner. okay.

Contributions like the one below (Extract 10) where the performative verb *speculate* is used in conjunction with the conditional auxiliary *would* are an absolute exception:

Extract 10. History grade 10 (Industrial Revolution; study 4)

Sm: **seeing this graph we ah can only ah specu**
T2: speculate?
Sm: yeah **speculate** but ah **I would say** ahm yeah ahm I **would just say** that because in that area ahm the life is so good that life quality that ah many people preferred to go there.

To summarize, CDFs are often co-constructed by teachers and students, as students rarely produce complete CDFs on their own accord. As for linguistic realization, learners tend to use similar, often very basic, markers while explicit markers as well as conditional auxiliaries are usually avoided.

5 Conclusion

In this paper we present a summary account of five independent studies which have applied Dalton-Puffer's (2013, 2016) Construct of Cognitive Discourse Functions to different sets of CLIL and EFL data from Austrian secondary education classrooms. The CDF Construct has been proposed as a conceptualisation of routine verbal-cognitive classroom activities that addresses language and content-subject educators alike due to its interdisciplinary theoretical foundations. A second function of the construct is to serve as a heuristic in analysing the content-directed spoken and written language in CLIL in a way that maps meaningfully with pedagogical conceptualisations present in the non-language subjects. The aim of the present article, then, was to test the CDF Construct's applicability in the analysis of oral CLIL classroom interaction and thereby progress towards its empirical validation via seeking answers to a series of research questions regarding the occurrence, distribution and realization of the different CDF types which make up the construct.

    The combined findings of five individual studies show that all elements of the CDF Construct do occur in naturalistic CLIL classroom interaction across a range of subjects including social and natural science lessons as well as one data-set of English as a Foreign Language lessons. The division of labour, as it were, between

the seven CDF types, however, is not even; in all but one study DESCRIBE was the most frequently observed CDF with EXPLAIN and DEFINE as runners up, while talking about hypothetical aspects of the matter at hand (EXPLORE) and verbalizing epistemic dimensions as well as stance-taking (EVALUATE) tend to be rather side-lined in the classrooms observed. Metacommunication about CDFs was rare and indirect. On the analytical level of who performs CDFs, the analyses showed a varied degree of student- vs. teacher-centredness, with the EFL lessons exhibiting the greatest share of student-produced CDFs. It is a constant across all analytical levels that influences of individual teaching style, subject traditions and requirements of the topic at hand must be taken into account in the interpretation. These variables are omnipresent in classroom-based research and will defy strict control.

Alongside providing first answers to a number of mostly quantitative research questions regarding the occurrence of CDFs in naturalistic CLIL classroom discourse, an important aim of the studies reported in this article has been to provide insight into the applicability of the CDF Construct as a heuristic in classroom discourse analysis. In sum, the five studies have encountered numerous methodological challenges leading to important insights firstly about the notion of CDF itself as the analyses have shown CDFs to be organized on two hierarchical levels: the primary of baseline-level of the single function and a secondary level of the CDF episode, where longer stretches of talk clearly serving one particular function incorporate utterances pertaining to other CDFs as steps on the way towards achieving the superordinate communicative goal. In how far these CDF episodes might be linked to classroom genres must be the object of further examination and discussion. A second set of important insights concerned the implementation of the CDF Construct as an actual coding instrument. Through a series of developmental steps across the five studies, a consolidated coding instrument has emerged which can now be used and tested in further studies (coding instrument to be reported in a future publication).

There is no shortage of research questions that merit pursuing in connection with CDFs. It will be highly interesting to take the CDF analysis to classrooms taught in the main language of a specific education system, which may be the first but also the second language of students (but usually the first language of teachers). A further necessary line of investigation are more detailed corpus-linguistic studies on the linguistic realization of CDFs by CLIL classroom participants. Apart from being interesting in itself, such an inquiry can serve as a needs analysis for the development of language support materials and/or interventions. In terms of standard English linguistic resources a fair amount of groundwork has been carried out in the ESP and EAP literature (Trimble 1985; Mohan 1986; Basturkmen 2006; Paltridge 2013; Flowerdew 2015) which can be complemented by studies on native speaker realizations in corpora such as MICASE.

It is a strength of the CDF Construct that it regards CDFs as verbalization schemata that are generic and general, thus enabling comparison across contexts, subjects, and languages. In further studies it will, however, also be necessary to take account of subject-specific, typical realizations of functions that emerge from the characteristic practices of individual subjects. In such undertakings it would be highly desirable to work in interdisciplinary teams including subject education experts in order to secure the conceptual linkage between CDFs and the respective subject's understandings of knowledge and competences to be acquired and demonstrated. Study 4 (Bauer-Marschallinger 2016) is a prototype of such a study.

A crucial direction for CDF-research to go will be intervention studies where explicit attention is paid to CDFs in classroom teaching and possible effects of modified teacher talk on student performance are measured and analysed. A doctoral project including teaching interventions which focus on individual CDFs in a collaborative science-ESP teaching environment is currently under way (Hasenberger 2017). Research and development work done in Singapore regarding explicit attention to explanations and argumentation in oral/written academic language in secondary education (e.g. Kramer-Dahl, Teo and Chia 2007; Tang 2015) has produced encouraging results in this respect. German-speaking educational linguists working to enhance teaching and learning in content-subjects are currently directing their attention to the use of writing in classroom learning/ teaching with the help of so-called "Textprozeduren" (textual procedures, Feilke 2014; Rotter and Schmölzer-Eibinger 2015). The CDF Construct has an important contribution to make in the pursuit of this overall research interest: its generic nature and its theoretical conception at a discourse pragmatic level makes it relevant for both written and spoken language and – most importantly – bridges the otherwise separate worlds of content education and language education.

References

Ahrenholz, Bernt (ed.). 2010. *Fachunterricht und Deutsch als Zweitsprache*. Tübingen: Narr.

Basturkmen, Helen, Shawn Loewen & Rod Ellis. 2002. Metalanguage in focus on form in the communicative classroom. *Language Awareness* 11(1), 1–13.

Basturkmen, Helen. 2006. *Ideas and options in English for specific purposes*. Mahwah, N.J. : Lawrence Erlbaum Associates.

Bauer-Marschallinger, Silvia. 2016. *Acquisition of historical competences in the CLIL History classroom*. Vienna: University of Vienna MA Thesis. http://othes.univie.ac.at/42043/ .

Brückl, Katharina. 2016. *The use of cognitive discourse functions in Austrian CLIL Economics lessons*. Vienna: University of Vienna MA Thesis. http://othes.univie.ac.at/42432/ .

Christie, Frances. 2002. *Classroom discourse analysis. A functional perspective*. London: Continuum.

Coyle, Do. 2007. Content and Language Integrated Learning: Towards a connected research agenda for CLIL pedagogies. *The International Journal of Bilingual Education and Bilingualism* 10(5). 543–562.

Dalton-Puffer, Christiane. 2007a. Academic language functions in a CLIL environment. In David Marsh & Dieter Wolff (eds.), *Diverse contexts – converging goals*, 201–210. Frankfurt: Peter Lang.

Dalton-Puffer, Christiane. 2007b. *Discourse in content and language integrated learning (CLIL) classrooms*. Amsterdam: John Benjamins.

Dalton-Puffer, Christiane. 2013. A construct of cognitive discourse functions for conceptualising content-language integration in CLIL and multilingual education. *European Journal of Applied Linguistics* 1(2). 216–253.

Dalton-Puffer, Christiane. 2016. Cognitive discourse functions: specifying and integrative interdisciplinary construct. In Tarja Nikula, Emma Dafouz, Pat Moore & Ute Smit (eds.), *Conceptualising integration in CLIL and multilingual education*, 29–54. (Bilingual Education and Bilingualism 101). Bristol, Buffalo & Toronto: Multilingual Matters.

Ehlich, Konrad & Jochen Rehbein. 1986. *Muster und Institution. Untersuchungen zur schulischen Kommunikation*. Tübingen: Narr.

Feilke, Helmuth. 2014. Argumente für eine Didaktik der Textprozeduren. In Helmuth Feilke & Thomas Bachmann (eds.), *Werkzeuge des Schreibens. Beiträge zu einer Didaktik der Textprozeduren*. 11–34. Stuttgart: Fillibach bei Klett.

Flowerdew, Lynne. 2015. Corpus-Based Research and Pedagogy in EAP: From Lexis to Genre *Language Teaching* 48(1). 99–116.

Halliday, Michael A.K. 1993. Towards a language-based theory of learning. *Linguistics and Education* 5. 93–116.

Halliday, Michael A.K. 1994. *An Introduction to Functional Grammar*, 2nd ed. London: Arnold.

Hasenberger, Thomas. 2017. Content and language integrated curriculum design: the potential of cognitive discourse functions. Paper presented at 9th AILA-Europe Junior Researchers Meeting. University of Vienna, 6–8 September.

Hofmann, Victoria & Jennifer Hopf. 2015. *An analysis of cognitive discourse functions in Austrian CLIL biology lessons*. Vienna: University of Vienna MA Thesis. http://othes.univie.ac.at/37658/.

Kidd, Richard. 1996. Teaching academic language functions at the secondary level. *Canadian Modern Language Review* 52. 285–307.

Kramer-Dahl, Anneliese, Peter Teo & Alexander Chia. 2007. Supporting knowledge construction and literate talk in secondary social studies. *Linguistics and Education* 18. 167–199.

Kröss, Lisa Maria. 2014. *Cognitive discourse functions in upper secondary CLIL Physics lessons*. Vienna: University of Vienna MA Thesis. http://othes.univie.ac.at/33460/.

Lechner, Lisa. 2016. *Cognitive discourse functions in Austria upper secondary EFL classes*. Vienna: University of Vienna MA Thesis. http://othes.univie.ac.at/41378/.

Lemke, Jay L. 1990. Talking science: language, learning, and values. (Language and Educational Processes). Norwood, N.J: Ablex Pub. Corp.

Llinares, Ana & Tom Morton. 2010. Historical explanations as situated practice in content and language integrated learning. *Classroom Discourse* 1(1). 46–65.

Lose, Jana. 2007. The language of scientific discourse: Ergebnisse einer empirisch-deskriptiven Interaktionsanalyse zur Verwendung fachbezogener Diskursfunktionen im bilingualen Biologieunterricht. In Daniela Caspari, Wolfgang Hallet, Anke Wegner & Wolfgang Zydatiß

(eds.), *Bilingualer Unterricht macht Schule. Beiträge aus der Praxisforschung*, 97–107. Frankfurt am Main: Peter Lang.

Mercer, Neil. 2000. *Words and minds: How we use language to think together*. London: Routledge.

Meyer, Oliver. 2010. Towards quality-CLIL: successful planning and teaching strategies. *Puls* 33. 11–29.

Mohan, Bernard. 1986. *Language and content*. Reading, MA: Addison-Wesley Publishing Company.

Nikula, Tanja, Emma Dafouz, Pat Moore & Ute Smit (eds.). 2016. *Conceptualising integration CLIL and multilingual education*. Clevedon: Multilingual Matters.

Paltridge, Brian (ed.). 2013. *The handbook of English for specific purposes*. Malden, Mass.: Wiley-Blackwell.

Rotter, Daniela & Sabine Schmölzer-Eibinger. 2015. Schreiben als Medium des Lernens in der Zweitsprache. Förderung literaler Kompetenz im Fachunterricht durch eine „Prozedurenorientierte Didaktik und Focus on Form". In Sabine Schmölzer-Eibinger & Eike Thürmann (eds.), *Schreiben als Medium des Lernens. Kompetenzentwicklung durch Schreiben im Fachunterricht*, 73–97. Münster/New York: Waxmann.

Schleppegrell, Mary. 2004. *The language of schooling: A functional linguistics perspective*. New York: Routledge.

Schmölzer-Eibinger, Sabine. 2013. Sprache als Medium des Lernens im Fach. In Michael Becker-Mrotzek, Karen Schramm, Eike Thürmann & Helmut Johannes Vollmer (eds.), *Sprache im Fach. Sprachlichkeit und fachliches Lernen*. Münster/New York: Waxmann, 25–40.

Schrönkhammer, Markus. 2012. Communication and interaction in Content and Language Integrated Learning (CLIL) classes in Physics: a theory-based analysis of classroom practice in Austrian schools. Vienna: University of Vienna MA Thesis. http://othes.univie.ac.at/21803/.

Snow, Catherine .E. 1987. Beyond conversation: Second language learners' acquisition of description and explanation. In James.P. Lantolf & Angela Labarca (eds.), *Research in second language learning: Focus on the classroom: Proceedings of the 6th Delaware Symposium on Language Studies, October 1984*, 3–16. Norwood: Ablex.

Tang, Kevin. 2015. The PRO instructional strategy in the construction of scientific explanations. *Teaching Science* 61(4). 14–21.

Thürmann, Eike & Johannes H. Vollmer. 2013. Schulsprache und sprachsensibler Fachunterricht: Eine Checkliste mit Erläuterungen. In Charlotte Röhner & Britta Hövelbrinks (eds.), *Fachbezogene Sprachförderung in Deutsch als Zweitsprache*, 212–232. Weinheim: Juventa Beltz.

Trimble, Louis. 1985. *English for science and technology: A discourse approach*. Cambridge: Cambridge University Press.

Zydatiß, Wolfgang. 2010. Parameter einer bilingualen Didaktik für das integrierte Sach-Sprachlernen im Fachunterricht: die CLIL Perspektive. In Bernt Ahrenholz (ed.), *Fachunterricht und Deutsch als Zweitsprache*, 133–152. Tübingen: Narr