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Anmerkung zur Verfassung dieser Diplomarbeit

Diese Diplomarbeit wurde in Zusammenarbeit von Victoria Hofmann und Jennifer Hopf verfasst. Die Datenerhebung und deren Bearbeitung erfolgte gemeinsam, wohingegen die schriftliche Diskussion der Ergebnisse getrennt durchgeführt wurde. Die gemeinsame Bearbeitung des Themas ermöglichte eine umfangreichere empirische Studie auf quantitativer und qualitativer Ebene. Sowohl im Inhaltsverzeichnis als auch in den einzelnen Kapitelüberschriften ist der Name der jeweiligen Verfasserin vermerkt.

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1. Introduction

Little consideration has so far been dedicated to what might be a key relevant issue to CLIL education – the bridge between content and language. In theory, the concept of CLIL aims at the integration of language and content but practice has revealed this vision to be wishful thinking. In a great majority of cases, CLIL lessons abide by the rules of content lessons, while minor attention is granted to the target language. In the light of this deficiency, Dalton-Puffer has formulated a concept designed to bridge this gap. Her construct of *cognitive discourse functions (CDFs)* was first presented in the article *A construct of cognitive discourse functions for conceptualising content-language integration in CLIL and multilingual education* (2013) and suggests seven academic language functions central to classroom discourse as the common denominator, which may link linguistic and subject-related matters. Given their potential significance for CLIL, we argue that cognitive discourse functions deserve explicit professional awareness. Hence, this thesis aims to provide empirical support for Dalton-Puffer's construct. As such, it is expected to provide insight into language patterns and interactional mechanisms in a didactic context, creating a more profound understanding in the CDF field of expertise. A total of eight lessons, recorded in Austrian CLIL classrooms, will build the basis of our analysis which is going to broach quantitative as well as qualitative dimensions of CDFs and their realisation on a meta-level. A discussion of relevant literature forms the backbone of our analysis.

2. Introducing CLIL (Hofmann)

Before taking a closer look at cognitive discourse functions it is perhaps convenient to dedicate a few words to the educational context within which they will be integrated in this thesis, CLIL. As the full name, Content and Language Integrated Learning, already suggests, the main objective of CLIL is to embed the learning of a foreign language in the context of a content subject. The dual-focused approach attempts to create a learning environment favourable for developing "proficiency in both the non-language subject and the language in which it is taught, attaching the same importance to each" (Eurydice 2006: 7). In contrast to other approaches, CLIL aims at the deliberate integration of subject-knowledge and language-knowledge, stressing "that the non-language subject is not taught *in* a foreign language but *with* and *through* a foreign language" (Eurydice 2006: 7). Theoretically any foreign language could be taught in CLIL but in practice English is the most commonly used language, the predominant reason being its international number one position with regard to globalisation and cross-national communication. It is thus a socio-political motivation which foregrounds English as the main language operating in CLIL classrooms, apart from a selected few other prestigious languages such as French in a few German-French Secondary Schools (Dalton 2007: 1). It is the two-fold focus of CLIL that distinguishes it from other similar forms of integrated language learning (Coyle 2007: 545) such as EAA, "Englisch als Arbeitssprache" (see for example Nezbeda 2005) in Austria and many more in international contexts (for a list see e.g. http://www.onestopenglish.com/clil/what-is-clil/).

The European Union acknowledged the socio-political value of a wide English-speaking community from an early onset. Since 1995, only one year after the coining of the term *CLIL* by David Marsh (2002), the EU has regularly drawn attention to the pivotal importance of educational programmes that encourage multilingualism to "create a channel of shared understandings" (Coyle 2007: 544) and to make the European Union

> the most dynamic and competitive knowledge economy in the world […]This method [CLIL] can contribute to individual and collective prosperity and can strengthen social cohesion. The method thus presents a practical tool for promoting European citizenship while increasing student and worker mobility. (Council of the European Union, press release, May 2005)

The positive attention from the EU has mobilised generous funding for language research groups, material development and teacher trainings. CLIL is a bearer of hope to enable the realisation of the European Union's language goal of 'Mother

Tongue + 2' to create a more mobile community within the EU and increase economic potential and competitiveness (Ioannou Georgiou 2012: 496).

2.1. Aims, objectives and limitations

The primary advantage of CLIL is the acquisition of language proficiency within a content subject, particular emphasis resting on the 'naturalness' of the learning environment (Dalton-Puffer 2007: 3). As such, the language that is being handled within the CLIL classroom originates from the students' authentic motivation to learn language in order to understand content. Language, in this sense, becomes an indispensable tool to enable students to achieve knowledge and understanding, an idea which conveniently constitutes the foundation of both Communicative Language Teaching and Task-Based-Learning (Dalton-Puffer 2007: 3).

CLIL aims to draw attention to language- and content learning in equal measure (Mehisto, Marsh & Frigols 2008: 9). Practice has revealed this balance between language and content to be wishful thinking and far off reality: some students may lack the elementary knowledge of the foreign language which the content subject is supposed to be taught in, a circumstance which challenges weak students two-fold, from the language side as well as from the content side. Although CLIL is said to be different to other English-medium programmes in that it does not require learners to possess the language proficiency required for the successful learning of the content subject before commencing study (Graddol 2006), this indeed poses difficulties in the realisation of CLIL classes. In practice it is the teacher who becomes the key figure responsible for the compensation of possible language deficiencies on the students' side by target-oriented didactic methods and meaningful language work to raise learners' awareness. Dalton-Puffer (2015: 2), however, argues that many CLIL teachers share their students' status of foreign learners of English and feel that language-specific issues apart from vocabulary work do not reside within their field of professional competence. Mohan & Slater (2005: 152) agree that the teaching of technical terms constitutes the primary focus in CLIL lessons and point out that learning to “talk science” (Mohan & Slater 2005: 152) is a process rooted deeply within fields of competence other than the articulation of specialist terms and phrases.

Concrete objectives of CLIL as well as guidelines for teachers, students and parents have been formulated by the team of international language experts around David Marsh from the University of Jyväskylä, Finland. Certain studies have shown that the applicability of such guidelines are often problematic due to a high time-expenditure and insufficient suitability for daily use (http://www.oesz.at/download/diss/Praxisreihe_13.pdf). The development of a so-called *CLIL quality matrix*, which is designed to constitute the central pillar of CLIL lessons, has led to the formulation of sixteen different but interlinked criterial fields focusing on the balanced and effective integration of language and content (http://archive.ecml.at/mtp2/CLILmatrix/EN/qMain.html). These sixteen parameters are comprised as follows: the four main categories ‘Content’, ‘Language’, ‘Integration’ and ‘Learning’ are again divided into four sub-sections each; ‘Culture’, ‘Communication’, ‘Cognition’ and ‘Community’. In accordance with the matrix, high-quality CLIL classrooms should pay attention to ample and varied teaching methods that draw students’ attention not only to matters directly linked to the content under scrutiny but raise their awareness of larger concepts such as ‘culture’ in broader contexts.

By now no less than twenty European countries are participating actively in the CLIL programme(http://archive.ecml.at/mtp2/CLILmatrix/EN/qMain.html). Encouragement for the implementation comes from various sides in most cases; parents understand that the mastery of English may be a significant advantage for their child’s future on the labour market, whereas teachers have increasingly become disillusioned with language teaching practices, being seldom more than teaching-to-the-test situations, and have looked towards CLIL as an innovative tool offering an opportunity to immerse in professional fulfillment (Ioannou Georgiou 2012: 497).

2.2. Research findings on CLIL

It has been shown that students achieve better results in language tests due to CLIL lessons. They are provided with an additional opportunity to practice English during CLIL classes while their regular language education is not reduced, which increases their time dedicated to language learning. In fact, test scores demonstrate that "CLIL students' receptive and productive lexicon is larger overall, contains more words from lower frequency bands, has a wider stylistic range, and is used more appropriately" (Dalton-Puffer 2011: 186). The best elaborated competence of CLIL students in comparison to non-CLIL students seems to be spontaneous oral production; students reveal a higher speaking confidence, flexibility and fluency, followed by writing, where CLIL learners tend to apply more complex morpho-syntactic structures (Dalton-Puffer 2011: 186-187). Research about learners' content learning outcomes has not been so extensive, primarily owing to the fact that only few countries carry out standardized tests in science subjects (Dalton-Puffer 2011: 188). The main findings indicate that content-learning results of CLIL learners are fairly equal to those of non-CLIL learners (Dalton-Puffer 2011: 189). Nevertheless, studies do exist which topicalise both higher and lower levels of CLIL students, the first arguing that learners' tolerance of frustration as well as semantic processing skills might be better developed, while the latter points to reduced students' participation during science classes as the foreign language is often regarded as an obstacle (Dalton 2011: 188).

2.3 Implementation in Austria

The Austrian Centre of Language Competence (ÖSZ) as national contact point of the European Centre of Modern Languages has strived to put into practice the language goals formulated by the European Union and the Council of Europe. Austria has played a pivotal role in the development of the aforementioned CLIL matrix during the period of 2004–2007 by the European Centre of Modern Languages with its headquarters in Graz (Gierlinger et al. 2010: 5).

Dalton (2007: 46) states that the first realisations of CLIL in Austria have been a grassroots phenomenon, originating not from authoritative institutions but from teachers who sought new professional challenges themselves. This "innovative impetus" (Dalton-Puffer 2007: 47) from the staff was soon taken up by schools' representatives so as to promote the schools' pioneering language policy.

A major inconvenience that the Austrian CLIL scene is currently facing is the continual absence of a clearly defined framework of CLIL objectives and teaching methods (Dalton-Puffer 2007: 47), partly due to its grassroots development, but also due to lack of nationalwide curricular models. Teachers in this regard appear to miss out on the appropriate institutional and financial support, their gratification being "exclusively symbolic" (Dalton-Puffer 2007: 47) and their motivation predominantly of intrinsic nature.

In the last fifteen years or so a drastic increase in the professional attention turned towards CLIL teaching in Austria can be observed. A series of studies and surveys (e.g. Dalton-Puffer & Smit 2007, Annau 2002, Mewald 2015) looked into the national CLIL scene to put under scrutiny certain aspects such as the relationship between lexical range and communicative competence, question asking, speech acts and academic language functions, the latter being the topic of this thesis.

3. Language and science (Hopf)

As already pointed out in the introduction, this thesis is concerned with the investigation of different discourse functions appearing in CLIL Biology lessons. Although the lessons investigated for this study are generally set in a science environment, language issues will be the centre of investigation. On this account, the following section will provide information on the importance of language in science classes, as well as the particular nature of scientific language.

3.1. Points of intersection

The aim of education should not be to present knowledge in an isolated manner. As Vollmer (2010: 6) underlines, school should prepare students to be citizens that are able to handle their lives in society and for that they need special tools and a place to develop their potential. Regarding science education, teachers are not supposed to only concentrate on teaching science specific structures, concepts and knowledge, but they should rather aim towards a broader understanding of science, its contributions to our society and its limitations (Vollmer 2010: 6). Vollmer summarising claims that

> science education is based on socio-critical values raising question [sic] of relevance, of contextualisation and possibly of reduction of the science content […] vis-à-vis the limited time given and the need to include dealing with socio-scientific issues (personal and societal issues with a science dimension) in the classroom. Only this will prepare learners for the application of scientific knowledge and for scientific reasoning outside school, in life, participating actively as citizens in this area. (Vollmer 2010: 7)

Science-related issues, either global topics like climate change or local ones like energy supply, influence people's everyday lives and as a citizen of a democratic state, one should be able to participate in debates or decision-making processes concerned with these issues (Vollmer 2010: 6). Vollmer states, that this ability to contribute to such important issues is based on two things. First, a certain knowledge basis is needed, that helps understanding main concepts and processes, and additionally provides insight into "contextual dependencies of science", concretely addressing the interaction of science and society (Vollmer 2010: 6). The second necessary competence regards communication and language, since people have to be able to formulate their knowledge, to interpret information, to discuss certain issues and to inform about their own point of view (Vollmer 2010: 6). Vollmer here points out the importance of language for science education and hence draws attention to the points of intersection for these disciplines.

The Austrian curriculum for lower and upper secondary also draws on the relevance of language awareness and competences for all content-subjects. The first part of the Austrian curriculum's general section, which aims to address all teachers of lower and higher secondary education, concentrates on general learning goals. This section (https://www.bmbf.gv.at/schulen/unterricht/lp/11668_11668.pdf?4dzgm2) provides the following statement concerning language education.

> Bildungsbereich Sprache und Kommunikation Ausdrucks-, Denk-, Kommunikations- und Handlungsfähigkeit sind in hohem Maße von der Sprachkompetenz abhängig. In jedem Unterrichtsgegenstand sind die Schülerinnen und Schüler mit und über Sprache – zB auch in Form von Bildsprache – zu befähigen, ihre kognitiven, emotionalen, sozialen und kreativen Kapazitäten zu nutzen und zu erweitern [Education in language and communication, as well as one's personal ability to express oneself, think, communicate and act are all highly depending on language competences. In every school subject students are supposed to be enabled to use and expand their cognitive, emotional, social and creative capacities via the use of language].

Although not addressing science in particular, language education is demanded to be part of all subjects taught in a school context. Given that this thesis is concerned with Biology CLIL lessons, a further look at the Austrian curricula addressing Biology lessons of lower and upper secondary in particular is of relevance. Unfortunately, one might quickly realise that language issues are a comparably insignificant part of these guidelines. For lower secondary only one short sentence addresses the importance of supporting the development of scientific as well as everyday language (https://www.bmbf.gv.at/schulen/unterricht/lp/ahs5_779.pdf?4dzgm2).

Although the curriculum for upper secondary Biology lessons suggests the promotion of language competences in a comparably minimalistic manner, interestingly, scientific literature in English is explicitly mentioned as being favourable (https://www.bmbf.gv.at/schulen/unterricht/lp/lp_neu_ahs_08_11860.pdf?4dzgm2). This suggestion is most probably motivated by the fact that nowadays most scientific publications are written in English and if teachers want to prepare their students for the real scientific world they have to provide authentic language material. A further point mentioned in the Biology curriculum for upper secondary, which might be considered relevant for language education is presented by the following extract.

> Die Schülerinnen und Schüler sollen Wissen und Kompetenzen erwerben, die sie in Hinblick auf zukünftige Partizipation an gesellschaftlichen Entscheidungen qualifizieren. Werte und Normen, Fragen der Verantwortung (Bioethik) bei der Anwendung naturwissenschaftlicher bzw. biologischer Erkenntnisse sollen thematisiert werden. [Students are supposed to acquire knowledge and competences that qualify them to contribute to future decisions made by society. Principles, norms and responsibility questions (bioethics) regarding the application of scientific/biological knowledge should be addressed.] (https://www.bmbf.gv.at/schulen/unterricht/lp/lp_neu_ahs_08_11860.pdf?4dzgm2)

This part of the curriculum directly addresses an issue which Vollmer (2010: 6), as discussed before, stated to depend to certain extent on language competences. For taking part in the decision-making-processes of for instance environmental issues, people certainly need content knowledge on the one hand, but would not be able to express their arguments and vision based on this knowledge without language and communication competences.

In conclusion, language issues might not be addressed directly or in great depth by the Biology curriculum, but especially the guidelines for upper secondary offer some suggestions that can certainly be interpreted as language-related.

3.2. The language of science

That the language of science is different from other semantic fields of language can be considered common knowledge. As Reeves (2005: 7) points out, especially comparing it with poetic language illustrates what exactly this difference is caused by. First, certain similarities are observable since both language fields share special characteristics. Scientists, as well as poets aim to find the perfect words to express a certain experiment, they observe and interpret carefully, and though in different ways, they cherish the elegance of a statement (Reeves 2005: 7). The nevertheless striking difference is caused by cultural and professional traditions and the separation of the two communities. While poetic writers are concerned with establishing “what is singular, subjective, ambiguous and mutable”, scientists’ language is expressing “what is true or constant most of the time under most conditions, what is generally applicable to various contexts" (Reeves 2005: 7).

A further interesting issue when the interaction of language and science is concerned is the use of particular language, triggered by science content. "Learning science means learning to talk science" is what Lemke proposes at the very beginning of his book *Talking Science* (Lemke 1990: 1). Apparently it has to be taken into consideration that not only language competences as such are important for science education, but that for talking about science-related topics special language knowledge is sometimes needed and has to be taught. Lemke claims that "[t]eaching them [students] to use the specialized language of science in speaking, writing and reasoning is essential to every goal of science education" (Lemke 1990: 167). He further points out the importance of being able to use the "specialized conceptual language" of science, to establish oneself among a group of people that communicate in this language (Lemke 1990: 1).

However, although the special semantic patterns and ways of making meaning used in science discourse may be unique to the field of science, they are learned like any other feature of language, namely by practicing them with people that are aware of their application in situations where their use is required (Lemke 1990: 1). Thus, like Lemke points out, no special way of thinking is necessary for mastering the language of science. One certainly has to be aware of specialized themes but in science discourse they are put together by the same language skills that are used in any other form of discourse (Lemke 1990: 153).

3.3. Overlap in educational issues

In addition to the natural embedment of language issues into content-subject matters, caused by the simple need for communicating these matters, teaching approaches like CLIL aim to provide a space where language and content encounter each other in a guided educational context by integrating targeted methods. Although the goal of CLIL lessons is the integration of language in subjects, the focus often lies on content-related issues, which turns CLIL lessons into plain content lessons taught through the medium of a foreign language

(Dalton-Puffer 2013:219). With the objective of adjusting this lack of integration, Dalton-Puffer has looked for a common denominator of content subjects and language education. She claims that to ensure integration of content and language in CLIL classrooms, the pedagogies of both subjects need to be combined and an area of overlap has to be found (Dalton-Puffer 2013: 219). C*ognitive discourse functions,* which are going to be discussed in detail during the course of the following chapters, seem to represent this important area of overlap (Dalton-Puffer 2013: 242).

4. Dalton-Puffer's CDF Construct (Hopf)

Given that this thesis is concerned with a quantitative and qualitative analysis of *cognitive discourse functions (CDFs)* as perceived and characterized by Dalton-Puffer (2013), the construct that serves as a basis for this study needs to be introduced. For this reason, the following chapter aims to provide an overview of Dalton-Puffer's construct, initially proposed in her article *A construct of cognitive discourse functions for conceptualising content-language integration in CLIL and multilingual education* (2013).

One of the main questions Dalton-Puffer's construct of CDFs is supposed to answer is "how to equip learners with the linguistic competences that are required for educational success" (Dalton-Puffer 2013: 218). Being able to reach this goal is a question of language education, which is as opposed to common believes, not exclusively the responsibility of language teachers. As discussed in the previous chapter, especially the general section of the Austrian curriculum for lower and higher secondary education (https://www.bmbf.gv.at/schulen/unterricht/lp/ 11668_11668.pdf?4dzgm2) addresses this issue and underlines the important role language plays in every school subject. Although only dedicating one sentence to this issue, the curriculum particularly designed for biology education directly calls upon biology teachers to support the development of science- as well as everyday language competences (https://www.bmbf.gv.at/schulen/unterricht/lp/ahs5_779.pdf?4dzgm2).

Without doubt, content classes can potentially be a place for approaching language issues, and concepts like CLIL promise this integration of language learning and content. Yet, in practise most CLIL lessons are taught like content-lessons, only through the medium of a foreign language (Dalton-Puffer 2013: 218-219). In other words, rarely any targeted language learning takes place and the pedagogies of for instance science subjects shape the lesson structure. According to Dalton-Puffer (2013: 219), combining the different pedagogies of both, content and language subject, could solve this dilemma. Therefore she introduces the construct of *cognitive discourse functions*, which links up "subject specific cognitive learning goals with the linguistic representations they receive in classroom interaction" (Dalton-Puffer 2013: 219).

4.1. Theoretical background

Dalton-Puffer's (2013) CDF construct is grounded on prior literature and studies on educational objectives; she takes into account a subject-specific perspective as well as an applied linguistics perspective. Consulting and reviewing different literature on subject-educational learning objectives (e.g. Anderson & Krathwohl et al. 2001; Biggs & Tang's 2011, Bailey & Butler 2003 and Vollmer 2010), Dalton-Puffer compiles a list of 54 different cognitive learning goals, which she labels as "functions" (Dalton-Puffer 2013: 224).

Subject-specific perspective

Starting with the subject- or content-education perspective, Dalton-Puffer (2013: 221) draws attention to the great variety of subjects taught in a second language context and the consequential diverseness of pedagogies and aims. Although the curricula of many countries are to a certain extent standard-based, there are cultural differences which enlarge the variety of subject-related aims (Dalton-Puffer 2013: 221). Apart from these varieties, different subject pedagogies share the reference to certain constructs, also discussed by Dalton-Puffer. They are different in many senses, but all have in common that they deal with the verbal expression of cognitive processes.

One of these constructs is Bloom et al.'s *Taxonomy of educational objectives* (1956), revised by Anderson & Krathwohl et al. (2001), which serves, alongside other purposes, as an instrument for curriculum development in different countries (Dalton-Puffer 2013: 221).

Table 1. Taxonomy Table (Anderson & Krathwohl et al. 2001: 28)

THE KNOWLEDGE DIMENSION	**THE COGNITIVE PROCESS DIMENSION**					
	1. REMEMBER	2. UNDERSTAND	3. APPLY	4. ANALYZE	5. EVALUATE	6. CREATE
A. FACTUAL KNOWLEDGE						
B. CONCEPTUAL KNOWLEDGE						
C. PROCEDURAL KNOWLEDGE						
D. META-COGNITIVE KNOWLEDGE						

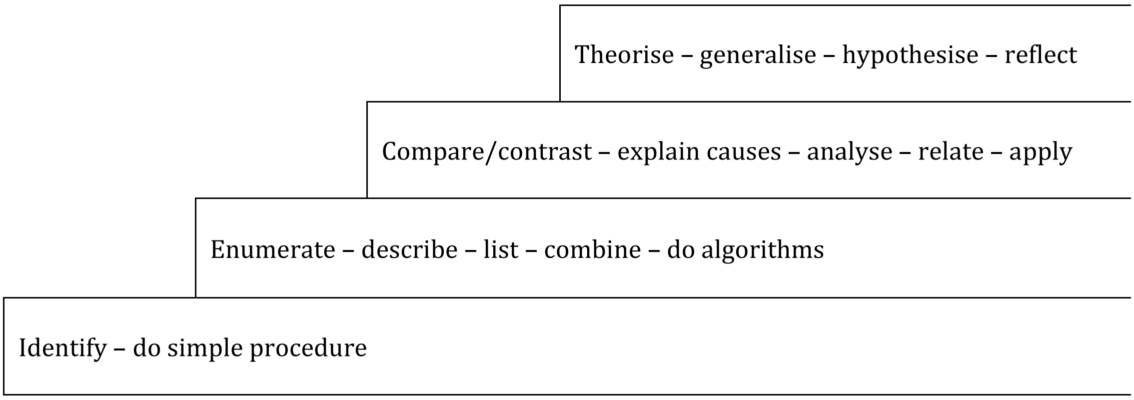
Table 1 illustrates how Anderson & Krathwohl et al. (2001) rearrange the material provided by Bloom et al. (1956) in a two-dimensional matrix consisting of four different knowledge dimensions and six cognitive process dimensions. They claim that objectives of all subjects combine knowledge and cognitive processes, and thus can be classified via this taxonomy and placed in one or more cells of the *Taxonomy Table* (Anderson & Krathwohl et al. 2001: 27). Dalton-Puffer (2013: 222) mentions these cognitive processes and especially aspects from 'understand', 'analyse' and 'evaluate' to be relevant for her own construct. To each of the processes listed in the *Taxonomy Table*, at least two specific cognitive processes can be assigned, which add up to nineteen cognitive processes constituting the six categories (Anderson and Krathwohl et al. 2001: 30), presented in Table 2.

Table 2. The six categories of the cognitive process dimension with assigned specific cognitive processes adapted from Anderson & Krathwohl et al. (2001: 31)

Categories	Specific cognitive processes
REMEMBER	RECOGNISING, RECALLING
UNDERSTAND	INTERPRETING, EXEMPLIFYING, CLASSIFYING, SUMMARISING, INFERRING, COMPARING, EXPLAINING
APPLY	EXECUTING, IMPLEMENTING
ANALYSE	DIFFERENTIATING, ORGANISING, ATTRIBUTING
EVALUATE	CHECKING, CRITIQUING
CREATE	GENERATING, PLANNING, PRODUCING

Despite its importance and influence on many educational issues, Dalton-Puffer (2013: 222) clarifies that Anderson & Krathwohl et al.'s revised taxonomy is not the only elaborated concept concerning learning goals and hence proceeds by looking at further literature. Biggs & Tang's *Teaching for quality learning at university* (2011) for instance is related closely to the European context and therefore also relevant for the CDF construct. Dalton-Puffer (2013: 222-223) summarizes and simplifies their postulated hierarchy of learning outcomes and concentrates on the mental processes to make them comparable to Anderson & Krathwohl et al.'s taxonomy.

Figure 1. Verbs for formulating learning outcomes based on Biggs & Tang (2011); simplified by Dalton-Puffer (2013: 222)



Dalton-Puffer mentions the work of Bailey in collaboration with several partners (for a list see Dalton-Puffer 2013: 223) to be similar to this elaboration. When approaching the issue of required proficiency levels for academic language in the context of US high schools, they encountered highly varying expectations regarding the students' demonstration of knowledge and academic language proficiency. Nonetheless, mostly in curricula documents, some concrete aspects were mentioned and like presented in Biggs & Tang's (2011) hierarchy before, linguistic behaviour was expressed in the form of verbs (Dalton-Puffer 2013: 223). The verbs describing cognitive processes, mentioned by Bailey & Butler (2003: 16) to be generally relevant for middle and high school students, are *compare, explain, identify, describe* and *recognize*. When further considering verbs expressing the requirements regarding K-12 ESL standards, they collected verbs like *ask, clarify, express, imitate, listen, negotiate, participate, request*, and *respond* (Bailey & Butler 2003: 17).

Another source Dalton-Puffer takes into consideration, when discussing the subject-education perspective regarding learning objectives, is the project *Languages in other Subjects* (http://www.coe.int/t/dg4/linguistic/langeduc/BoxD2-OtherSub_en.asp#s7), for which a team of professionals in the fields of language and subject education cooperated to clarify which communicative competences are necessary in compulsory education (Dalton-Puffer 2013: 223). For the current thesis especially Vollmer's (2010) individual paper, which was already mentioned in the previous chapter, concentrating on science education, is of great relevance. The potential discourse functions mentioned by him are relevant for this study, and also part of Dalton-Puffers list of 54 potential functions. Vollmer (2010: 21) describes his postulated discourse functions as "the discursive representation of both the cognitive processes and their linguistic realisation (in the sense of enactment) brought into play for the development/exposition of knowledge" and divides them up into more basic macro functions which can include several micro functions.

Table 3. Macro and micro functions adapted from Vollmer (2010: 22-23)

Macro functions	**Micro functions**
SEARCHING (explorative function) NAMING/POINTING (indexical function) DESCRIBING (referential function) NARRATING (narrative function) EXPLAINING (relating function) ARGUING (argumentative function) EVALUATING (evaluative function) NEGOTIATING (interactive function) CREATING (creative function)	*asking questions* *questioning* *guessing* *identifying* *classifying* *labelling* *collecting* *selecting* *reporting* *summarizing* *presenting* *sequencing* *relating* *structuring* *contrasting* *hypothesizing* *predicting*

According to Vollmer's (2010: 23) understanding, micro functions, especially those applied in science education, play only a role in specific contexts, like *reporting*, which is mostly used in the context of experimenting in class. Interestingly, three of these functions which Vollmer only categorizes as micro function are included by Dalton-Puffer as main CDFs into her construct of *cognitive discourse functions*.

Applied linguistics perspective

As already mentioned before, in establishing her CDF construct, Dalton-Puffer (2013) refers not only to literature concentrating on the content-subjects' aspects, but also takes an applied linguistics' perspective into consideration, since language learning and educational language are fields of study this discipline is concerned with since its very beginnings. She states that issues concerning second language learning and the role which language in general plays for school learning encounter each other when content is taught through the medium of a second or foreign language (Dalton-Puffer 2013: 224).

One work reviewed on by Dalton-Puffer (2013: 225) deriving from the field of applied linguistic, is Cummins' (2000) concept *of Basic Interpersonal Communication Skills (BICS)* and *Cognitive Academic Language Ability (CALP)*. As Dalton-Puffer (2013: 225-226) describes, it has been widely acknowledged that generally language learner progress faster in terms of their BICS than their CALP, but that, as Cummins points out, one's academic language knowledge concerning a certain content area might be further developed than their general communication skills. Dalton-Puffer (2013: 226) further refers to Cummins (2000) when pointing out that classroom interaction is pivotal to the development of both, BICS as well as CALP. And this classroom interaction, she states, should provide room for "juxtaposing different oral and literate uses of language, with teachers guiding students in extending their repertoires towards the literate end" (Dalton-Puffer 2013: 227).

Under these described circumstances, the implementation of CDFs can be observed, since, as Dalton-Puffer (2015: 4) points out, they "are patterns which emerge from the needs humans have when they deal with cognitive content for the purposes of learning, representing and exchanging knowledge", thus they are functions which are required in "the context of organized learning events".

4.2. The construct

Dalton-Puffer's construct of c*ognitive discourse functions*, as already mentioned, draws attention to a field of multilingual classroom discourse for which an integration of language and content pedagogies is necessary. As Dalton-Puffer (2013: 216) states, CDFs provide "a zone of convergence" since cognitive processes concerned with the subject-matter are externalised through verbalization. Based on pragmatic theory, she further assumes that

> there is an underlying communicative intention of the speaker to let others know which cognitive steps they are taking in handling subject content, in sharing knowledge items and knowledge structures and in making them intersubjectively accessible. Intersubjective accessibility is the precondition for institutional learning to become possible at all and one must hence assume that such communicative intentions become relevant for all participants in the learning situation at different times. In other words, CDFs concern both, learners and teachers. (Dalton-Puffer 2015: 4)

The formulation of different communicative intentions of cognitive processes, relevant and accessible for all participants, plays a crucial role in Dalton-Puffer's construct. As discussed before, the starting point of the concept was a collection of 54 functions, which she arranges in broader, more manageable groups. This arrangement is based on the formulation of the just discussed communicative intentions which she suggested for each type (Dalton-Puffer 2013: 233). The resulting seven types of *cognitive discourse functions* CLASSIFY, DEFINE, DESCRIBE, EVALUATE, EXPLAIN, EXPLORE and REPORT, as well as their core communicative intention, are illustrated in the following table.

Table 4. CDF types and their underlying communicative intentions (Dalton-Puffer 2013: 234)

Function Type	**Communicative Intention**	**Label**
Type 1	I tell you how we can cut up the world according to certain ideas	**CLASSIFY**
Type 2	I tell you about the extension of this object of specialist knowledge	**DEFINE**
Type 3	I tell you details of what can be seen (also metaphorically)	**DESCRIBE**
Type 4	I tell you what my position is vis a vis X	**EVALUATE**

Type 5	I give you reasons for and tell you cause/s of X	**EXPLAIN**
Type 6	I tell you something that is potential	**EXPLORE**
Type 7	I tell you about sth. external to our immediate context on which I have a legitimate knowledge claim	**REPORT**

As pointed out by Dalton-Puffer (2013: 235), the labels designating the different CDF types are not clear and unambiguous, since they are normal English words and their meaning is neither unitary nor stable and always depends on context. These categories arising from the illustrated classification further contain different numbers of various functions, exemplified by table 5.

Table 5. CDF categories and their members (Dalton-Puffer 2013: 235)

CLASSIFY	Classify, compare, contrast, match, structure, categorise, subsume
DEFINE	Define, identify, characterise
DESCRIBE	Describe, label, identify, name, specify
EVALUATE	Evaluate, judge, argue, justify, take a stance, critique, recommend, comment, reflect, appreciate
EXPLAIN	Explain, reason, express cause/effect, draw conclusions, deduce
EXPLORE	Explore, hypothesise, speculate, predict, guess, estimate, simulate, take other perspectives
REPORT	Report, inform, recount, narrate, present, summarise, relate

Looking at the table it becomes apparent that the seven categories are not equally extensive, causing that for instance compared to EVALUATE, DEFINE is a rather small category of *cognitive discourse functions* (Dalton-Puffer 2013: 235). Since the members of the different types of CDFs are not all equally adequate representatives of their groups and no perfectly prototypical member can be chosen, the categories are rather represented by their communicative intention than their members (Dalton-Puffer 2013: 236). As already becoming apparent, the categories forming the main CDFs, relevant for this study, are characterised by a complex internal structure which also causes borders between different types to be fuzzy in some instances (Dalton-Puffer 2013: 236).

5. Introducing the framework for CDF analysis

To provide accurate information about the complex structures of individual CDFs, the following sections will be concerned with a precise discussion of the different properties and realisations of each type of *cognitive discourse function*. Furthermore, meta-lingual issues will be considered. On this account, relevant literature for each of the seven CDFs is going to be discussed, while examples from the set of data collected for this study serve as a source of illustration. Additionally, previous findings gained from studies, also concerned with the implementation of CDFs and corresponding meta-talk in a CLIL environment, will be presented.

5.1. CLASSIFY (Hopf)

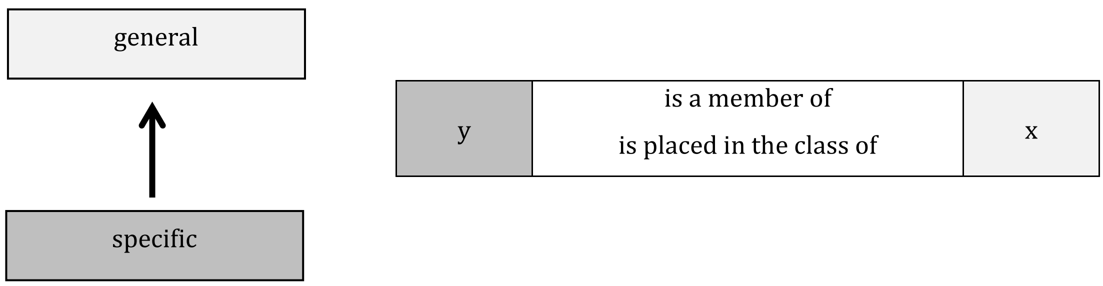
The first of the seven CDFs described in Dalton-Puffer's concept is CLASSIFY. While for instance Vollmer categorizes CLASSIFY to be a micro function, subordinated to more prominent major discourse functions and only occurring in special contexts (Vollmer 2010: 23), Dalton-Puffer ascribes major importance to it and integrates it into her model of cognitive discourse functions (Dalton-Puffer 2013: 234). Being able to classify is crucial to developing expertise in a special field, since the ability to classify and to understand categories has to be acquired with the help of experts and cannot be learned by observation or discovery (Dalton-Puffer 2015: 6). Trimble even takes this discussion step further and does not only point out the importance of classifying concerning specialized scientific discourse, but proclaims it to be "basic to human thinking" and thus, should be taught properly (1985: 85).

The general function of CLASSIFY is, as nicely summarized by Kröss, "to structure certain concepts by identifying similarities and to order them according to already existent systems." (2014: 15). She further underlines the apparent conformity of this definition with the communicative intention assigned to it by Dalton-Puffer, namely "I tell you how we can cut up the world according to certain ideas" (2013: 234).

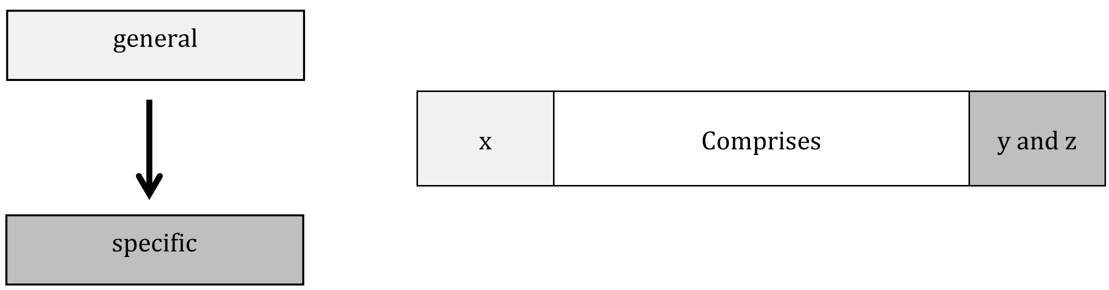
As pointed out by Trimble (1985: 85), the process of classifying can be realised in two different ways. When uttering a classification one can either determine the class to which certain members belong or the various members of a specific class are provided by the realiser (Trimble 1985: 85). In other words, CLASSIFY might either involve the search for a superordinate class or the class members. This issue is also approached by Widdowson et al. (1979a: 74), who claim that the realiser of a classification can proceed in two ways: from specific to general or from general to specific. They represent their idea of the two directions of CLASSIFY in the following illustration and additionally provide possible linguistic realisation (Widdowson et al. 1979a: 75).

Figure 2. Types of CLASSIFY according to direction

Type 1:



Type 2:



Also the corpus of data used for this study offers examples for both possible ways of realisation of CLASSIFY.

Example 1. CLASSIFY, **directions of classification**

a. T: Now listen; albinism is an example of a so-called recessive condition. (Type 1)
b. T: it takes place in cells. In in in in our cells, in animal cells, in plant cells. (Type 2)

Apart from this distinction regarding the direction of CLASSIFY, Trimble (1985: 86) further differentiates classifications into three types, which can be identified by the amount of information given, or the way of expressing this information. He provides the following list that precisely presents his understanding of the three different types of classifications.

> I. *Complete classification*. A complete classification gives the reader three kinds of information:
> 1. The name of the class (that is, the set)
> 2. The members of the class (that is, the sub-sets of the set) […]
> 3. The basis (or bases) for classification […]
>
> II. *Partial classification*. A partial classification gives the reader two kinds of information:
> 1. The name of the class
> 2. The members of the class (as above)
>
> III. *Implicit classification*. An implicit classification is found in a piece of discourse that has a rhetorical function other than classification. Most implicit classifications contain all three kinds of information listed under 'Complete classification' above, although it is not stated in classifying terms. […]. (Trimble 1985: 93)

A complete classification, as apparent from Trimble's summary, offers information about the class members, the class they belong to and the similarities and differences that indicate their relation. In some cases it is not required to state the third piece of information, the basis, explicitly, since it might also be implied by the class itself (Trimble 1985: 86). However, in example 2 all three relevant items of information are given explicitly.

Example 2. CLASSIFY, **complete classification**

> T: So this is, what kind of energy is ATP? {Sf: Ahm…} It's a, it's a chemical compound, so we call this energy?
> Sf: Ah, it's chemical energy? (laughs)
> T: Yeah, yeah, the chemical energy.

As further elaborated by Trimble (1985: 87), classes can either be "open-ended" or "closed" depending on if they are constituted of a finite number of class members or not. A closed class might be realised by listing all the different members of the class, but can also be realised by only presenting those members of a finite class, relevant for the current discussion. Hence, no matter what the realiser decides to include into the classification, if there is a finite number of members the class can be considered *closed*. An *open* class on the other hand, is composed of an infinite or uncountable number of members (Trimble 1985: 87). Having a look at example 3a and b, this distinction might become clear.

Example 3. CLASSIFY, **open and closed classifications**

a. T: Uhm then we will come to a special kind of diffusion and that's called osmosis.
b. T: Now; blood groups are an example; they're an example of so-called multiple alleles and co-dominance.

While example 3a discusses the finite class of 'types of diffusion' and hence might be categorized as *closed*, example 3b presents an *open* classification concerned with the endless class of 'multifactorial conditions'.

The second type of classification which Trimble (1985: 89) calls *partial classification*, provides the reader or listener with the members of a class and states the class itself, but completely leaves out the basis of classification, meaning the mutual or distinguishing information. Most often writers or speakers fail to state the basis of their classification because the understand it to be obvious (Trimble 1985: 89). In example 4 for instance, 'Huntington's disease' is classified as a 'dominant condition' but the teacher obviously expects his students to understand what this implies, without providing an adequate basis.

Example 4. CLASSIFY, **partial classification**

> T: Huntington's disease is a dominant condition.

Finally, the *implicit classification* features all the information which is essential for complete classifications, but does not present it in a typical classifying manner. As Trimble puts it, an "[i]mplicit classification refers to classifying information that is present in the text but not in classification terms" (1985: 90). In example 5 all the relevant information is offered that classifies 'lungs', 'moist skin' and 'gills' as 'places of gas exchange', nonetheless, the utterance does not share the linguistic features of a complete classification.

Example 5. CLASSIFY, **implicit classification**

> T: so in gas exchange, whether it's in lungs or in the skin, in the moist skin or in gills, it's always O2 crosses the membrane in one direction and CO2 in the other direction and it's always along a concentration gradient.

Apparently, there exists not only a close relation between different sub-types of classifications and other CDFs. Trimble (1985: 85) especially stresses similarities between CLASSIFY and the CDF type DEFINE. Dalton-Puffer (2013: 236) also takes account of this correlation and states that difficulties regarding the determination of clear boundaries between CDFs are a result of their complex internal structure. CLASSIFY is a perfect example of a CDF with fuzzy boundaries, since it may, according to Dalton-Puffer, always be considered part of DEFINE but on the other hand not every classification is a definition (2013: 236). Strictly speaking, there not only an overlap concerning the different types of CDFs is observed, but as a matter of fact, some of them even develop from others. In such manner, especially CLASSIFY and the classes this CDF is concerned with, are established by using criteria constituted by the descriptions of certain features (Widdowson et al. 1979a: 71). Owing to the fact that many CDFs bring on such correlations, there is no necessity for always handling the categories separately, since they in some situations include each other (Dalton-Puffer 2013: 236).

Previous findings

One noticeable issue which Lackner's (2012) study brought forth regarding the discourse function CLASSIFY in a classroom context, is that within the frame of his investigation, it is the least frequently occurring discourse function. Lackner (2012: 95) analyses history lessons and attempts to explain this trend by stating that CLASSIFY might rather be considered a science-related function and thus might not be a frequent element of history lessons discourse. However, this explanation is not supported by Kröss' (2014: 46) results, who investigates a science subject but equally finds CLASSIFY to be among the least frequent functions. On top of that, Lackner (2012: 95) observed that most of the few instances of CLASSIFY present in his data, were performed in an implicit manner, which requires students to deduce the classifying information from the utterance.

Another issue observed by Kröss (2014: 56) is an even distribution concerning the different realisers of CLASSIFY, meaning that classifications were equally often realised by teachers, students and students in cooperation with their teacher. However, the amount of data analysed was too limited as to make a general claim about the even distribution of CLASSIFY. Although Lackner's (2012: 97-100) analysis of realisers also revealed that classifications are uttered by students as well as teachers, his results indicate that especially if uttered as part of a monologue, CLASSIFY tends to be a teacher-realised function.

One last observable feature regarding the use of CLASSIFY pointed out by Kröss, is its use in connection with subject matters rather than language related issues and the finding that discourse on a meta-subject level, like a diagram, makes use of classifications too (Kröss 2014: 86).

5.2. DEFINE (Hofmann)

The first thing that captures one's attention with regard to Dalton-Puffer's (2015: 235) categorisation of cognitive discourse functions is the relatively scarce population of members in the category DEFINE, compared to other categories. It is comprised of no more than three elements, one being the name-giving *define*, along with *identify* and *characterize*. This deliberate choice may have two reasons: The first is the amount of attention that has already been dedicated to the task of defining definitions. Definitions are arguably the most widely studied rhetorical function (Dalton-Puffer 2015: 8), their structure and necessary elements pinned down precisely by extensive literature, not least because of their relatively compact nature in comparison to other rhetorical functions. The second reason for the scarcity of elements in the DEFINE category is perhaps located in the nature of definitions themselves. Longer and more complex definitions are usually comprised of shorter episodes involving other cognitive discourse functions, in most cases CLASSIFY and DESCRIBE (Trimble 1985: 75). Thus, the fact that some elements of DEFINE indeed are part of other rhetorical functions explains why the members listed in its own category are relatively few. Even these few members are not exclusively parts of definitions, as can be seen by a simple example: The member *identify* is defined by the *Collins online dictionary* as "to determine the taxonomic classification of (a plant or animal)" which in turn portrays a characterisation of the category CLASSIFY. Along similar lines, Dalton-Puffer (2015: 8) mentions that definitions involve the articulation of class membership, again relating them to classifications. The communicative intention underlying the discourse function DEFINE is "I tell you about the extension of this object of specialist knowledge" (Dalton-Puffer 2013: 234).

With regard to the structure of definitions, Trimble (1985: 75-80) differentiates between simple and complex definitions, the first being comprised of no more than a sentence or even a part of it, whereas the latter may stretch to considerable lengths including entire paragraphs. Trimble (1985: 75) stresses the particular need to address complex definitions due to their abundance in his data, a reason for this perhaps being his working primarily with written texts, where complex utterances are likely to be more frequent. In the following table, a brief outline of Trimble's categorisation of definitions will be given. It summarises the main differences of the three sub-categories of simple definitions.

Table 6. Types of *simple definitions*, based on Trimble (1985: 75-80)

<table>
<tr><th>Type of simple definition</th><th>Term</th><th>Class</th><th>Difference</th><th>Synonym</th></tr>
<tr><td>formal</td><td rowspan="4">×</td><td rowspan="4">×</td><td rowspan="4">×</td><td rowspan="4"></td></tr>
<tr><td>a. physical</td></tr>
<tr><td>b. function</td></tr>
<tr><td>b. purpose</td></tr>
<tr><td>semi-formal</td><td>×</td><td></td><td>×</td><td></td></tr>
<tr><td>non-formal</td><td>×</td><td></td><td></td><td>×</td></tr>
</table>

Simple definitions can be grouped into three hyponymous classes, which are 'simple formal', 'simple semi-formal' and 'simple non-formal'. Their names are of course suggestive to their level of precision, which decreases in order of appearance.

A *formal definition* is comprised of three necessary elements: firstly, the term itself; secondly, the class to which the term belongs; and thirdly, one or more differences that distinguish the defined term from other members of the class (Trimble 1985: 76) In most cases the term and the class maintain a hierarchical relationship to each other, the defined term being a hyponym of the class. Drawn from the biological concept of a species, these three elements are often referred to as 'Species', 'Genus' and 'Differentia' (Trimble 1985: 75-76), as in the exemplary equation *Homo sapiens (Species) = Homo (Genus) + qualities distinguishing humans from other anthropoid apes (Differentia)*. Two examples of formal definitions are provided below.

Example 6. DEFINE, **formal definitions**

a. T: in eukaryotes, these are all organisms that have a nucleus
b. T: albinism is an inherited condition where people do not have any body colour

In example 6a the term is 'eukaryotes', the class is 'organisms' and the difference is 'have a nucleus'. Similarly, in example 6b the defined term is 'albinism', the hypernym is 'inherited condition' and the differentiating characteristic is 'do not have any body colour'.

The main characteristic of a *semi-formal definition* is the omission of the class of which it constitutes a sub-part. Trimble (1085: 77) suggests two reasons for this omission: either the class is obvious and explicit mention rendered superfluous, or it is too extensive for inclusion, as can be observed in examples 7a-b.

Example 7. DEFINE, **semi-formal definitions** [all T-realised]

a. so in other words meiosis is the formation of gametes
b. incomplete dominance, where indeed you can have the possibility of having a pink flower

The example from 7a shows a case where the class 'biological process' is omitted because it is obvious. The correct formal definition would be *Meiosis is the biological process by which gametes are formed*. Similarly, the class 'inheritance' in example 7b is left out, as it is obvious from the context in which the statement occurred. Dalton-Puffer (2015: 9) points out the high concordance of formal and semi-formal definitions regarding authorship in her corpus of 40 CLIL lessons. She argues that teachers are more likely to produce formal definitions, owing to their professional approach to language, while students resort to less sophisticated versions, such as semi-formal definitions.

Non-formal definitions, meanwhile, provide very little information about the term under scrutiny (Trimble 1985: 78). The most common form of a non-formal definition is synonymy, thus, one term being defined through another one which shares most of its characteristics. The advantage of practicality of this form of definition stands in the foreground, as some definitions by synonym are not even strictly-speaking correct.

Example 8. DEFINE, **non-formal definitions** [all T-realised]

a. alleles are factors
b. heterozygous means 'the same'

In example 8a the teacher defines alleles as factors, but the two terms do not share a synonymous relationship, but a hierarchical one. Alleles are **kinds** of factors, meaning that in this example the term has been replaced by the hypernym, the class. In example 8b the term is defined by a simple synonymous explanation.

There is need to address yet another sub-category of non-formal definitions, which was first implemented by Kröss (2014). The type *DEFINE-translation* describes all passages where difficult words or new scientific vocabulary are defined by a synonym in German, that is, most student's mother tongue. The category had been established with the aim to attain a clear differentiation between synonymy in the target language, i.e. English, and the translation equivalent. The sub-type DEFINE-translation is given in example 9.

Example 9. DEFINE, **translation**.

> T: do you know what 'semi' uhm, what 'semi' means? [SM].
> Sm: uhm halb
> T: halb, yes and 'permeable' means
> Sf: durchlässig
> T: durchlässig, wonderful

Turning to *complex definitions*, there can be distinguished another three sub-categories; definition by stipulation, by operation, and by explication (Trimble 1985: 81-84.). The main function of a definition by stipulation is to agree on certain limitations to a core definition, whence also the name results from. In mathematical stipulations a value or symbol is attributed to a variable or formula. It is important to stress that these stipulated attributes count only in the present situation and are not generalisable or transferable. The difference between such a mathematical stipulation and a formal definition is given in example 10. Another form of stipulation that may be of relevance for CLIL classrooms are general stipulations, which occur when scientists coin (new) names or terms for discoveries, processes, or objects.

Example 10. DEFINE, **mathematical stipulation** (a) and **formal definition** (b)

a. In this formula X represents the vertical vector (source: quoted in Weisman 1962: 135)
b. X is the female sex-chromosome (our invention)

The second sub-category of complex definitions is *definition by operation*. A simple definition of a new term or item is enhanced by description as to how this item is to be handled. Naturally, such operational definitions occur in environments where processes play a significant role. In CLIL classroom, definitions by operation may turn up in connection to experiments, where the teacher explains how an experiment is to be carried out. Clearly, operational definitions are closely related to process descriptions, with the only difference that what is being talked about is new and needs to be defined first.

Example 11. DEFINE, **definition by operation**

> The sound [f] is a voiceless, labio-dental fricative, formed by placing the upper lip lightly against the upper teeth, closing the vellum, and forcing the breath out through the spaces between the teeth or between the teeth and the upper lip. (source: quoted in Weisman 1962: 136)

The third kind of complex definition are *explications*, where a newly defined term is added information in the form of synonyms or phrases, with the purpose of clarifying the originally defined item. In example 12 the teacher explicates what he means by the ratio 3:1.

Example 12. DEFINE, **definition by explication**

> T: uh so basically what he got in the F2 generation is called a a a three purple, to one white. So 3:1 actually means 75% of the plants were purple, purple flowers, and 25% of the plants had white flowers

Finally, Gillet et al. (2009: 115) differentiate between two further types of definitions regarding the order of appearance of the three elements 'term', 'class' and 'difference'. *Real definitions* begin with the term to be defined, followed by the class and the difference, whereas *nominal definitions* display the opposite arrangement, initiating the definition with the class and the difference, and ending with the term. In this sense, the two structures

a. 'X is a Y that…'
b. 'X is a type of Y that…"

constitute real definitions, while

c. 'A Y that…is X'

d. 'A type of Y which ... is X'

are nominal definitions (see also example 6).

Example 13. DEFINE, **real** and **nominal definition** [all T-realised]

a. the phenotype is, is phenotype [X] is actually nothing more than a fancy way of saying what are the characteristics [Y] of the organism.
b. the characteristics [Y] which are seen or which are expressed he called or are called phenotype [X].

Examples 13a and 13b demonstrate the difference between real and nominal definition. In the first sentence the defined term *phenotype* is in the initial position, and in the second sentence it is positioned at the rear end of the utterance.

Widdowson (1979a: 59) relates real and nominal definitions to the theme that is being expressed in a sentence.

Figure 3. *Real* and *nominal definitions* (Widdowson et al. 1979a: 57)

Real definition	name of concept (theme)	*is defined as*	class + characteristics
Nominal definition	class + characteristics (theme)	*is called/known as*	name of concept

From figure 3 it becomes clear that in real definitions the term being defined is the theme of the sentence, whereas in nominal definitions the emphasis lies on the characteristics which distinguish the new term from other members of the class.

Previous findings

Dalton-Puffer (2007: 132-136) highlights the considerably low level of occurrences of definitions in her extensive corpus of 40 Austrian CLIL lessons, seventeen of those lessons displaying an entire lack of definitions. Few of the found definitions were types of the "full form" (Dalton-Puffer 2007: 132), that is, formal definitions, and most of these were uttered by the teacher. Most student-authored definitions were semi-formal ones, leaving out the superordinate class because it was rendered obvious from the context (Dalton Puffer 2007: 134). A rather frequent phenomenon seemed to be definitions collectively formulated by teachers and one or various students, where the role of the teacher was to provide a kind of 'trigger' in order to get the students started on the construction of the definition (Dalton Puffer 2007: 135). A further observation worth mentioning is the opposite reactions from teachers and students upon requests for information about a specific term: teachers generally disprefer translations into German, first attempting a synonym or hypernym, while students in most cases answer by providing the equivalent word in German (Dalton Puffer 2007: 136). In Kröss' study (2014: 46) DEFINE took up middle-ground in terms of frequency in comparison with the rest of the CDFs. With an average proportion of 14 percent it was preceded by DESCRIBE, EXPLAIN and REPORT. Very striking figures yielded the sub-type DEFINE-translation, which was level with, and once even outran, all other definition types put together in three of the six lessons. Translations thus appear to constitute a very persistent form of definition, although it has to be noted that in the lessons of one of the three teachers no translations occurred at all. Kröss (2014: 51) concludes that definitions are dependent on both the teacher, as well as the lesson, realisations varying from teacher to teacher and across different lessons of the same teacher. As concerns authorship of definitions, the study supports Dalton-Puffer's findings that most occurrences are co-constructed by teacher and students. Translations, on the other hand, were predominantly performed by teachers, a result which is interesting in the light of Dalton-Puffer's opposite observation.

5.3. DESCRIBE (Hopf)

As part of her concept of c*ritical discourse functions*, DESCRIBE is referred to by Dalton Puffer (2015: 10) as

> an activity where a speaker/writer informs a listener/reader about the observable features, qualities, or external and sometimes also internal characteristics of something in third person position.

Further elaborating on the 'something' in this definition, she clarifies that descriptions can concentrate on objects, as well as entities, persons, situations, events or processes (Dalton-Puffer 2015: 10). Discussing the overall purpose of DESCRIBE, namely informing about the characteristics of 'something', the communicative intention of this CDF type is abstracted as "I tell you details of what can be seen (also metaphorically)" (Dalton-Puffer 2013: 234). Lackner (2012: 49) follows a similar, yet more realizer-centred approach by defining the purpose of DESCRIBE as "telling you what I see", instead of telling what "can be seen" (Dalton-Puffer 2013: 234), and therefore implies the influence of a certain amount of realiser-subjectivity on descriptions. However, both of these described intentions lend weight to the assumption that by uttering a description a speaker rather than to solve "a comprehension difficulty on part of the addressee", as it is the case with other CDFs, the intention is to simply inform the listener (Dalton-Puffer 2015: 10).

Each description type includes certain information (Widdowson et al. 1979a: 34) and thus may refer to characteristics like "shape, size, weight, colour, texture, position in space" and several more (Dalton-Puffer 2015: 11). One thing that especially science-related descriptions have in common, according to Schleppegrell (1998: 187), is their timeless and generic nature. However, the apparent existence of different types and purposes of descriptions calls for a proper discussion of sub-types of DESCRIBE.

Formed on previous identifications of different description types provided by researchers like Widdowson et al. (1979a) or Trimble (1985), Kröss (2014: 22) suggests to break down the CDF DESCRIBE into four sub-categories according to different types of information offered by them. The four types she proposes to be most frequently mentioned by ESP researchers are *physical, structural, functional* and *process descriptions* (Kröss 2014: 22). In practice, strict boundaries are again hard to set, since the different types often correlate or include each other. In this sense, a physical description can easily be part of a process description (Trimble 1985: 71). Considering Kröss' selection of sub-categories of DESCRIBE, account has to be taken of the close relationship between physical and structural descriptions. While Kröss (2014) and also

Lackner (2012) approach structural descriptions as an independent description type, Dalton-Puffer's (2015: 11) understanding of DESCRIBE rather complies with Trimble's concept, who does not refer to structural descriptions as a separate type (1985: 71-74). Due to the fact that the data collected for this study reveals that structural issues of descriptions are especially useful for approaching certain biology content, structural descriptions are treated as an independent sub-category.

The first type of descriptions, the *physical descriptions*, may contain, as Trimble (1985: 71) points out, "the physical characteristics of an object and the spatial relations of the parts of the object to one another and to the whole, and of the whole to other objects concerned, if any". He further provides a list which contains the following most frequently described physical characteristics: dimension, shape, weight, material, volume, colour and texture (Trimble 1985: 71). How general or specific physical descriptions are can vary a lot in EST discourse. Compared to general physical descriptions like *above* or *to the right*, a specific description provides more precise information like actual distances or other linguistic units that might specify a description (Trimble 1985: 71). The following example nicely illustrates how during the course of a student-teacher conversation it might occur that a general description is altered into a more specific physical description.

Example 14. DESCRIBE, **physical description**

> Sf: we have the enzymes, uhm, for the, uhm, ATP molecule in the, uhm, mitochondria.
> T: M-hm. Yes in the membrane of the mitochondria.

While the physical description, 'in the, uhm, mitochondria', uttered by the student is of a general nature, the following extended description provided by the teacher is more precise and might already be classified as a specific description.

The second type of DESCRIBE, namely *structural descriptions,* are always built on what Lackner (2012: 51) calls a "part-whole relationship". In biology education such descriptions might be used for instance when discussing the plant cell and the different cell organelles it is composed of. Regarding the part-whole relationship of structural descriptions, in this case the plant cell represents the 'whole' as opposed to the organelles, which serve as the 'parts'. Likewise, in another structural description a plant cell might represent a part that constitutes a whole plant. Also Widdowson et al. (1979b: 39-40) exemplify structural descriptions by providing an example from the field of biology. They discuss the structure of a human skeleton and the bones it is constituted of through the realisation of this description type. According to Lackner (2012: 52), the part-whole relationship crucial to this sub-type of DESCRIBE can be realized in two different directions, comparable to the directional distinction of CLASSIFY, described before. Based on the understanding of structural descriptions presented by Widdowson et al. (1979b) and Gillet et al. (2009), Lackner suggests the following tables for illustrating the two types of realisations.

Figure 4. *Structural Description* Type 1and 2 (Lackner 2012: 52)

Type 1:

Whole	consists of is divided into is made up of includes	Parts

Type 2:

Parts	make up form	Whole

As can be inferred from these figures, structural descriptions are either realized by presenting a 'whole' and then discussing the different 'parts' it contains, like exemplified by example 15, or otherwise by stating which 'parts' a certain 'whole' is made of (Lackner 2012: 52).

Example 15. DESCRIBE, **structural description**

> T: What's the cytoskeleton made of; could you name any part of the cytoskeleton; maybe [Sf]?
> Sf: Ahm, filaments…intermediate filaments and the microtubules.
> T: Yes, so different filaments, protein fibres.

When uttering a *functional description*, the focus again either lies on the whole device or on its separate parts. Hence, a functional description might state the purpose of the whole device, or concentrates on the function of the device's main parts (Trimble 1985: 72). Staying with the previously established example of plant cells, a functional description might describe the different functions of these whole cells, but also the purpose of their organelles might be described. Lackner (2012: 53) again summarizes preceding works by Widdowson et al. (1979b) and Gillet et al. (2009) in an illustration, which provides canonical, corpus-tested linguistic implementation of functional descriptions.

Figure 5. *Functional Description* Type 1 and 2, adapted from Lackner (2012: 53)

Type 1:

whole/part	serves to is responsible for performs the function of controls regulates	*function*

Type 2:

The A One	function purpose aim objective role	of the	*whole/part*	is to	*function*

A correlation between the CDF EXPLAIN and DESCRIBE is indicated by Trimble (1985: 2), who mentions the phenomenon of causality frequently being associated with functional descriptions. Looking at linguistic realisation presented by the two figures provided by Lackner (2012), this notion of causality built into functional descriptions becomes evident and the following example perfectly illustrates its practical realisation.

Example 16. DESCRIBE,

> T: And this U-tube has got a semi-permeable membrane that separates these two, two parts of this glass vessel.

If in the case of example 16 the words *that separates* were exchanged by a phrase like *which causes the separation of*, the aspect of causality and the similarity between this description and an explanation would even become more apparent.

The last of the four main sub-types of DESCRIBE are *process descriptions* which refer, like defined by Trimble (1985: 72), to "a series of step or stages that are interrelated in that each step (but the first) is dependent on the preceding step and that all steps lead towards a definite goal". No step that leads to the determined goal and thus might be relevant for the addressee, is left out in a process description (Trimble 1985: 72). Besides mentioning, just as Trimble (1985), that main aspects of this description type are determining and sequencing different stages of a process, Widdowson et al. (1979a: 41) additionally state that process descriptions further inform about the changes happening from step to step, the purpose of a process and the methods and components used in different stages. Often, process descriptions come into use when instructions are given, in which case they are usually realized as imperatives (Trimble 1985: 72).

As already discussed in the context of other CDFs, there are instances of overlap and certain CDFs tend to correlate with each other. Especially DESCRIBE shows the tendency to play a role in the realisation of other CDFs including EXPLAIN or REPORT and occasionally even DEFINE (Dalton-Puffer 2013: 236). Example 17 illustrates such an embedding of an explanation (bold) into a physical description.

Example 17. DESCRIBE

> T: Alveoli. You remember they are only one cell thin, so it's very, **the membrane is very thin, and so oxygen can diffuse into … these alveoli** … they are, they are surrounded by the capillaries.

Lackner (2012) and Kröss (2014) make an attempt to distinguish similar CDFs from certain types of DESCRIBE, by looking at the structure of their linguistic realisations. Structural descriptions, for instance, might be characterized by the "relation of meronymy", which they express with an *x is part of y* construction that distinguishes them from CLASSIFY and DEFINE, which express a "relation of hyponymy", realised as *x is a kind of y* (Lackner 2012: 52). Kröss (2014: 24) approaches the distinction between functional descriptions and EXPLAIN in a similar manner, stating that the structure *x causes y*, which constitutes functional descriptions, is simpler than the *x happens because y* construct used by EXPLAIN, which "add[s] the element of reasoning".

Previous findings

Owing to the high frequency of appearance reported by both, Lackner (2012) and Kröss (2014), DESCRIBE can be assumed to play a central role in CLIL classroom interaction. Based on her findings, Kröss (2014) suggests the following three explanations for the density of DESCRIBE occurrences in CLIL classroom discourse.

> 1. DESCRIBE […] [is] easy to realise. Teachers and students have understood
> the concept of the CDF type and thus feel comfortable using it.
>
> 2. Descriptions are a common feature of Physics lessons. This might also hold
> true for other subjects or classroom talk in general.
>
> 3. The concept of DESCRIBE covers many related operations and therefore
> more realisations are found that can be labelled 'DESCRIBE' (process descriptions, physical descriptions, functional descriptions, etc.) (Kröss 2014: 84).

Regarding the close relation between the subjects Physics and Biology, it might be an obvious assumption, that Kröss' second explanation is also true for Biology lessons, like those analysed for this thesis. The third explanation addresses an issue which is also of relevance for this study and hence will be discussed further in the course of the qualitative analysis of this CDF.

Lackner (2012: 74-93) too takes account of the possible division of DESCRIBE into several related sub-operations and analyses them separately. His data analysis on *physical descriptions* revealed that although academic descriptions demand a certain degree of explicitness, student-realized descriptions rather lack this feature. Instead of using locative terms like suggested by Trimble (1985), students tend to realize physical descriptions by means of demonstrative pronouns like *here* or *there* (Lackner 2012: 74). Another interesting finding of Lackner's study concerning language use is the tendency of teachers to use non-academic language when expressing a *structural description*. A very commonly used phrase when describing the relationship between a 'whole' and its 'parts' was *we have*, which can be classified as highly colloquial. A similar pattern could be observed with *functional descriptions,* which teachers tend to initiate via colloquial phrases like *what was that good for* (Lackner 2012: 80-84). The most prominent results concerning *process descriptions* regard their frequency which is, similar to functional descriptions, rather low (Lackner 2012: 86).

Both, Lackner (2012) and Kröss (2014) report a tendency towards a co-construction of DESCRIBE by students and teachers, causing them to be often uttered in the form of dialogues. Kröss (2014: 51) further suggests that the occurrence of this CDF might depend on the lesson itself, since she observed inconsistencies concerning the frequency of occurrence among the different lessons.

5.4. **EVALUATE** (Hofmann)

The cognitive discourse function EVALUATE is perhaps best distinguished from other such functions through its intrinsic judgmental nature (Kröss 214: 27). As such, an evaluation always carries a certain amount of subjectivity from the part of the realiser, which also renders it difficult to pin down an evaluation as correct or wrong. It is not surprising, therefore, that some authors have placed evaluations on a scale measuring complexity of discourse functions at the more complex end (Dalton-Puffer 2015: 13) The members of the category EVALUATE, according to Dalton-Puffer (2013: 235) are the following: *evaluate, judge, argue, justify, take a stance, critique, recommend, comment, reflect* and *appreciate.* In the light of the subjective nature of the mentioned members, Dalton-Puffer (2015: 13) stresses the need for an explicit statement of the underlying evidence, criteria, or set of standards, that give support to an evaluation. Although her formulation of the basic communicative intention, "I tell you what my position is vis a vis X" (Dalton-Puffer 2013: 234) does not include the call for any evidence, she goes into more detail when she determines the "underlying common denominator" of *evaluate*: "I am going to tell you my personal stance towards this. I have reasons for this position based on evidence, my previous knowledge and values" (Dalton-Puffer 2015: 13). Two examples should illustrate evidence-based evaluation:

Example 18. EVALUATION, **with justification**. [all T-realised]

a. [osmosis] it's such an important process it has got its own name
b. ah I'd be a little careful about these things, first of all inheritance of eye colour…I'm not quite certain whether it's really only one characteristic

In example 18a the teacher evaluates a process as important, her justification being the fact that the process has got its own name and is thus explicitly distinguished from regular diffusion. In example 18b the teacher justifies his stance (that the S should be careful) by adding scientific knowledge, i.e. that the inheritance of eye-colour is probably dependent on various factors and cannot be described by Mendel rules alone.

Evaluations are also part of Anderson & Krathwohl's (2001: 83) classification of the six major cognitive processes in educational contexts. Evaluation occurs through the attribution of certain judgments along a set of criteria, which are

a. quality
b. effectiveness
c. efficiency
d. consistency.

The formulation of sets of standards on the basis of which evaluations are made is an indispensable element in their construct of EVALUATE.

> It must be emphasized that not all judgments are evaluative. For example, students make judgments about whether a specific example fits within a category. They make judgments about the appropriateness of a particular procedure for a specific problem [...] Most of the cognitive processes, in fact, require some form of judgment. What most clearly differentiates Evaluate as defined here from other judgments made by students is the use of standards of performance with clearly defined criteria. (Anderson & Krathwohl 2001: 83)

Although the attribution of value judgments underlies a range of predetermined criteria, it always involves a certain degree of subjectivity from the part of the realiser, as already pointed out. Whether a biological process is deemed efficient or not may depend on different purposes of the process under scrutiny, or the attitude of the realiser to the process, or something else.

Anderson & Krathwohl (2001: 83-84) distinguish between two subcategories of evaluations, *checking* and *critiquing*. The first one refers to evaluation of an operation or product by testing it for internal faults, inconsistencies or contradictions. In this sense, 'checking' can be understood as the evaluation of the inner anatomy of a product or operation under observation, that is, if all its parts work according to plan. In the science classroom such kind of evaluation might appear in the form of a student's assessment of scientific study results, i.e. if the conclusions formulated by the scientist truly reflect the observed data. The second subcategory, 'critiquing', focuses on the external qualities by means of a set of externally imposed criteria and lies "at the core of what has been called critical thinking" (Anderson & Krathwohl 2001: 84). In a more figurative sense, if a product, process or system is compared to a human body, 'critiquing' comments on the outer characteristics of that body; that is, criteria like shape, size, mood, etc…; 'checking', on the other hand, is concerned with the inner anatomy; that is, if the heart nourishes all parts of the body with blood or leaves parts out. An example of 'critiquing' within a scientific context in education would be the evaluation of a student's hypothesis in terms of yielding positive and negative consequences, or in terms of efficiency.

Table 7. Types of evaluation, based on Anderson & Krathwohl (2001: 38-84), and Mautner (2011: 140-141)

Type of evaluation	Object of evaluation
Checking	**internal nature** of a product or process - consistency - contradictions - fallacies
Critiquing	**external nature** of a product or process - positive or negative - certain or uncertain - important or unimportant

Table 7. outlines the basic difference between 'checking' and 'critiquing'. In the first evaluative method, a process or system is checked for any kind of problems or inconsistencies; in the second method, the evaluative statement gives information in terms of a concrete position along a line of bipolar, external characteristics, such as degree of importance or degree of certainty.

For a clearer understanding of the distinctions between the two sub-types of EVALUATE, two examples from the corpus are provided, involving evaluative 'checking' and 'critiquing', respectively.

Example 19. EVALUATE, **checking**

> T: and now, for multiple alleles, we have several possibilities and in the case of blood groups we have three alleles. And I would like to ask you;

> what problem do we have now? Using the writing system, we have a practical problem.
> Sm1: es wird kompliziert.
> Sm2: jo weil…
> T: no, we have a practical problem…
> Sm2: we have only lower case and upper case.
> T: we've only lower case and upper case and now all of a sudden we have three alleles. You see what I mean?

Example 20. EVALUATE, **critiquing**

> T: uhm when organisms reproduce...that the next generation is somewhat different in...than the parent generation, this is really important because otherwise the species would not be able to adopt to a changing environment

While example 19 is an evaluation of the 'inner' structure or validity of an entire writing system, in example 20 the teacher comments on the importance of something as an 'outer' characteristic, and also gives the required justification by stating a reason for his evaluation.

Mautner (2011: 140-141) distinguishes between several dimensions of evaluation. She focuses on academic written language, which is the reason why her classifications may only find restricted applicability in the context of this study. Her criteria have a bipolar nature, which allows the placement of a text under scrutiny along a line between two opposite characteristics. Three such characteristics have been included in the previously discussed table 7 on page 37. They describe the external nature of a product or process, which is why they are characteristics of 'critiquing'. The exact position in between these bipolar stances can be identified by additional markers, which fine-tune the extremeness of an evaluation. All in all, Mautner mentions four categories of evaluative 'filters' (see table 8) which may be of significance in the analysis of spoken CLIL interaction.

Table 8. Types of evaluative 'filters', based on Mautner (2011: 141)

Type of operation	Example
1. modal verb	may, might, could
2. adverb	arguably, perhaps, possibly
3. downtoner	somewhat, rather, quite
4. restrictive conjunction	although, despite, nevertheless

The fundamental difference between a 'bare' evaluative statement and a 'filtered' one can be seen in examples 21a and 21b from Mautner (2011: 141-142).

Example 21. EVALUATE, **non-filtered** and **filtered evaluations**

a. This treatment is highly problematic – even if some older patients have been said to benefit from it.
b. Although, arguably, this treatment may seem somewhat problematic, it has significant and long-lasting benefits for older patients.

In example 21a the treatment is evaluated as something negative, the author taking a clearly pessimistic stance. In example 21b, meanwhile, the negative aspects of the treatment are remedied by the mention of beneficial effects, as well as by a row of evaluative filters, which render the statement less extreme.

Apart from the types of evaluations illustrated by Anderson & Krathwohl and Mautner, which are compatible with Dalton-Puffer's definition of the CDF-type EVALUATE, quite another kind of evaluation is presented by Lemke (1990: 6). In his view also the mere repetition of students' answers is a form of evaluation. He argues that if a teacher repeats a student's answer with a firm declarative intonation, the learner will interpret this as positive feedback. If the teacher remains silent or proceeds with a different topic, the students will "assume that this silence is tantamount to a negative Evaluation and will try a different answer." (Lemke 1990: 8) It follows from this argumentation that what he calls "positive evaluation" (Lemke 1990: 6) by teachers is no optional move, but indispensable for the learners' reassurance that their utterance was correct, such as in example 22.

Example 22. EVALUATION, **positive evaluation** of students' answer

> T: why is this important that the organelles are separated from the cytoplasm? Ahm [Sf1]…[Sf2], yes, sorry.
> Sf2: because the metabolic reactions need their own environment…
> T: yes they need their own environment, m-hm. Could you give an example?
> Sf2: the cell respiration.
> T: yes cell respiration for example, or another takes place in which organelle?
> Sf2: mitochondria.
> T: the mitochondria.

Despite the high frequency of such 'positive evaluations' in classroom discourse, they are not included in Dalton-Puffer's definition of EVALUATE, given their little informative value.

If the evaluation of students' answers by teachers is of significant relevance, clearly the opposite scenario must allow for some consideration as well. In practice, however, students' evaluations of their teachers' answers occurs very seldom (Lemke 1990: 7). It is an interesting phenomenon that teachers do most of the asking and learners most of the answering, although the first assume a professional status in their subject, while the latter is the group who generally lacks subject-related knowledge. In the rare cases that students do ask their teachers questions, the answers to these questions are hardly ever evaluated, be it due to the belief that teachers are all-knowing, or because students avoid to threaten their teacher's face openly in fear of possible consequences. It is likely that the hierarchical relationship between teachers and students that is at work in educational institutions is a decisive factor for this unequal distribution of evaluative judgements.

> And, once this pattern of inequality has been established as the norm in school, older children accept and even collude with it, becoming unwilling either to ask the sort of questions that might lead to a genuine instructional conversation or to go beyond giving minimal answers, even when a teacher's question calls for an expression of

their own opinions or an account of their personal experience. (Wells 2009: 4 of MS, quoted in Dalton-Puffer 2015: 15)

Previous findings

Results of Kröss' study (2014: 45-48) revealed strikingly few instances of EVALUATE in Austrian CLIL lessons. In relation to the other CDF types, evaluations constituted no more that 1% of her coded data. Five of her six analysed lessons lacked evaluations entirely, the remaining lesson containing one coded EVALUATE passage, which was realised by the teacher.

5.5. EXPLAIN (Hofmann)

Before going into detail about the internal structure of explanations, it is essential to cut its multifaceted semantic dimension down to the types of explanations that constitute Dalton Puffer's cognitive discourse function EXPLAIN. Explaining is the discourse function which has been investigated most extensively in literature (Dalton-Puffer 2013: 239), pointing at a manifold attempt to characterize the complex nature of explanations for didactic purposes. In Dalton-Puffer's writings dated earlier than her definition of the CDF construct (e.g. Dalton-Puffer 2007), *explaining* was used in a broader sense and includes types which have later on been explicitly omitted. Reasons for her choice of formulation of the final EXPLAIN construct will be addressed below.

Drawing on the OED entry of *explain*, three different semantic dimensions can be identified:

> *Type 1*… to make sth. plain or intelligible; to clear of obscurity or difficulty; to give
> details of or to unfold (a matter)
> *Type 2*… to give an account of one's intentions or motives
> *Type 3*… to make clear the cause, origin, or reason of

Explanation type 1 makes up the larger part of Dalton-Puffer's (2007) analysis of *explaining* in 40 CLIL lessons of different subjects. The mayor findings in this study revealed that students' explanations of a more complex nature could rarely be found in the corpus, because most explanations resulted from co-construction by both teacher and (various) student(s), the student(s) supplying small explanatory items, and the teacher stitching together these individual parts to a full explanation (Dalton-Puffer 2007: 58). Lackner (2012: 45) investigated the function of *explaining* in CLIL history lessons and made explicit the role of type 2, arguing that in historical contexts the motivational aspect is of particular significance. Why then, if type 3 has not yielded large amounts of data compared to the first two types, does it constitute the main type of Dalton-Puffer's EXPLAIN? There are several reasons for this deliberate arrangement: first of all, type 1 may make up most of the occasions of *explaining* in the corpora, but if one takes a closer look at the considerable extent of its definition, it is no longer surprising that many passages fall into its category. Owing to this overly ample dimension of type 1 it was excluded from Dalton-Puffer's construct.

A second possible explanation for the exclusion of type 1 is its 'all-rounder' nature, which renders a satisfactory distinction from other neighbouring CDFs difficult. After a closer inspection of explain type 1, it becomes evident that the some of its components semantically overlap with the OED entries of other cognitive discourse functions, mostly descriptions.

> *Define:* "to state exactly what (a thing) is; to set forth and explain the essential nature of"
>
> *Describe:* "to set forth in words, written or spoken, by reference to qualities, recognizable features, or characteristic marks; to give a detailed account of"

Dalton-Puffer (2015: 15) concludes that explanation type 1 is, in this regard, much more an expression of the totality of all other CDFs, in that they all contribute to an overall explicitness-function within the CLIL environment. This view can be supported by the frequent appearance of the verb *explain* and the noun *explanation* in meta discourse (Dalton-Puffer 2007: 155). Due to the relatively broad use of both words in everyday life and their lack of 'technical' connotation, such as definitions, for example, the verb *explain* or the noun *explanation* are often used as superordinate terms for other CDFs. Dalton-Puffer (2015: 10) observed that *explain* "seems to be used like a hypernym for other cognitive discourse verbs and acts as a dummy CDF as it were." This can be seen in example 26.

Example 26. EXPLAIN, **meta-talk**

> 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.

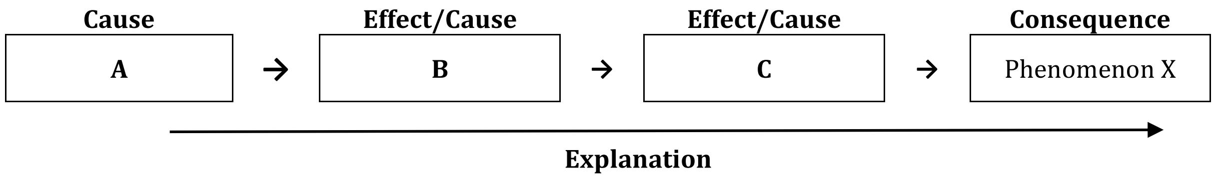
The teacher wants to introduce the new term *mono-hybrid*, telling the students that he will explain it while really what he does is provide a formal definition.

The reason for the particular stress of explanation type 3 in the majority of the reviewed literature (e.g. Anderson & Krathwohl 2001, Lose 2007, Vollmer 2010, Widdowson 1979b) is the significance of causal relations in scientific contexts (Dalton-Puffer 2015: 16). As such, relations in natural sciences are normally expressed by causes and consequences and characterise purely deductive phenomena. As opposed to history, where for instance the motivational aspect of political decisions may play a central role (Lackner 1012: 45), natural sciences, such as Biology or Physics, are bound to biological and physical processes, which are caused by and trigger other such processes.

Bearing this in mind, the final construct of the cognitive discourse function EXPLAIN contains the following communicative intention: "I give you reasons for and tell you cause/s of X" (Dalton-Puffer 2013: 234). This formulation highlights the necessity of a cause/consequence relation which aims to explain phenomena in CLIL classrooms. As a result, a variety of other functions are contained within the CDF type: apart from *explain,* there is also *reason, express cause/effect, draw conclusions*, and *deduce* (Dalton-Puffer 2013: 235).

Widdowson (1979b: 108) formulates the relation of cause and effect as a chain of reactions, which may again trigger other reactions, as can be seen in the figure below.

Figure 6. *Cause and effect*, adapted from Widdowson et al. (1979b: 108)



The end product is an explanation of the consequential phenomenon 'X' in terms of its causes 'A', 'B', and 'C'. The explanatory process is not required to run chronologically; it can also begin with the final consequence and work its way backwards to the primary cause, like in example 24. Here, the teacher and two students try to construct an explanation of the effects of the Brownian motion, a physical force that makes particles distribute without external energy.

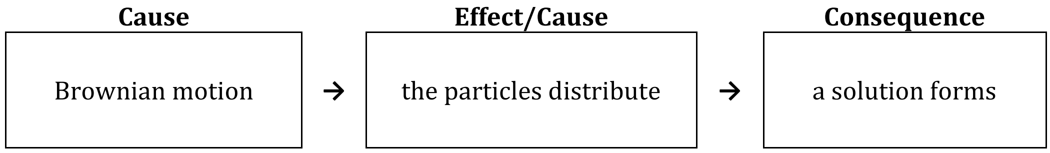
Example 24. EXPLAIN, **cause and effect chain**

> T: When it's a liquid then it's a solute and a solvent uh and what happens?
> Sf1: It becomes a solution.
> T: Yes. Because?
> Sf1: The solute is a ???
> T: Yes, so that's tiny particles and what do they do? These tiny particles in the solvent?
> Sf1: Uhm they are distributed
> T: Yes, they are distributed. Why do they distribute? What's the, what makes them move [Sf1]? What makes the tiny particles move?...It's called, uh after a guy. Yes [Sf2]
> Sf2: The Brownian motion
> T: Yes, the Brownian motion. Brownian uh movement, so that makes uh the particles move and spread.

In the above example, the chain of causes and effects is unraveled in the order opposite to the process, emphasising the relation between causes and effects, and not the chronological process as such. It starts with the consequence, *It becomes a solution*, and goes back all the way to the initial trigger, the 'Brownian motion'. The teacher even makes explicit that the 'Brownian motion' is the primary cause of the effect, *so that makes uh the particles move and spread.*

If the above information were arranged in a flowchart such as Widdowson's model, the logical relations between causes and effects would be easier identifiable.

Figure 7. Cause and effect chain



What becomes evident from the last example is the similarity of causal and consequential explanations to process descriptions. The main difference between the two discourse functions is perhaps the missing chronology in explanations. A process description would have a clear starting and end point and would therefore be presented only in chronological order. After all, it would make little sense to **describe the process** of digestion by starting with the colon, whereas it would make sense to **explain the effect** of a dysfunctional resorption of water in the colon.

Explanations can be separated into the two categories 'causality' and 'consequence' according to two characteristics: certain conjunctions and syntactic realisations (Widdowson 1979b: 118). In 'causality' explanations a reason is expressed in the main clause and conjunctions such as *because* and *as* establish a logical relation to the cause of something. In the 'consequence' explanations conjunctions like *therefore* and *so* introduce the consequence of a situation, which becomes the focus of the utterance (Lose 2007: 99). A second distinction can be made on the syntactic level of the realisations. An overview of both, conjunctions and syntax, is provided in table 9.

Table 9. *Causality* and *consequence*, based on Lose (2007: 99) and Widdowson et al. (1979b: 118)

Causality	Consequence
conjunctions	
as *because* *since*	*therefore* *for this reason* *consequently* *so* *if-clauses*
syntactic realisation	
'X because Y.' *'Because X, Y.'*	*'X. As a result/consequently, Y.'* *'If X, then Y.'*

Causes and consequences are also mentioned by Lemke (1990: Appendix C), who positions them in his toolbox of semantic relations in the category of 'logical relations,' along with 'Problem/Solution' and 'Action/Motivation'. Thereby he stresses the strong link between causes and consequences in that they are dependent on one another and can be discerned from other types by the logical relationship they maintain. This link between a consequence and the underlying cause(s) may not always be pinned down to a one-to-one relation, as Vollmer (2010: 7) points out, but can in fact be related to various causes. As a result, Vollmer (2010: 7) classifies explanations according to the type of relation they describe, either single- and multi-factorial phenomena. In the science classroom it is likely that explanations are mostly single-factorial due to the strong deductive nature at work, whereas it is plausible that explanations in a history lesson might be multi-factorial given the motivational dimension, for instance when outlining several possible reasons for a historical decision. What is bound to be of relevance in the science classroom is the differentiation between proximate and ultimate causes for an effect, which might even reside on different causal levels. (Vollmer 2010: 7). In this sense, the proximate reason for an albino having red eyes is the visible blood vessels, and the ultimate reason is the absence of the gene that codes the melanin pigment (see example 25).

Example 25. EXPLAIN, **proximate** and **ultimate causes**

> T: Why are the eyes reddish? Because you see the blood vessels **[proximate].** Okay? There is no pigment present to cover up the, the colour of the blood **[ultimate]**.

Further relevant insights into the functioning of EXPLAIN are made by Ogborn et al. (1996, referred to in Mohan & Slater 2005: 153), who stress the influence of descriptions and definitions in the construction of explanations. This strong interrelation is also observed by Halliday (1998, referred to in Mohan & Slater 2005: 153), who argues for the relevance of descriptions and definitions, alongside explanations, in the two patterns involved in science learning:

1. definition & description: constructing new taxonomies of concepts
2. explanation: constructing logical sequences of reasoning

Previous findings

Lemke (1990: 106) points out that teachers generally do not seem to be inclined to do extensive explaining. They prefer to organise their lessons mainly in the form of Triadic Dialogue, with the intention to increase students' participation. All the same, Bailey et al. (2002, referred to in Dalton-Puffer: 2013: 239) discovered that EXPLAIN is amongst the most frequent of discourse functions found both in teachers' as well as in students' talk. There is one other study immediately relevant to this one, given the shared school subject under analysis; Lose's study (2007) about *explaining* in 11 CLIL Biology lessons. Her major findings point to a very narrow range of lexico-grammatical features used by the learners when considered in relation to the level of proficiency they are supposed to have reached at their stage of language education (Dalton-Puffer 2013: 240). Dalton-Puffer's study (2007: 152-153) of various discourse functions in 40 observed CLIL lessons points at a very limited number of students' requests for particular explanations in classroom talk, requests mainly being made for facts. The opposite occasion happens more frequently, of course, but still around half of the lessons end without the teacher having asked for a student's explanation even once. Kröss (2014: 48-56) points out the strong correlation between the distribution of EXPLAIN and different topics of the subject. She argues that explanations are dependent on the particular topic of a lesson, and are not greatly influenced by the teacher, given that even among same teachers the occurrences differ greatly in different lessons. As concerns the type of authorship of explanations, Kröss' data indicates a high level of teacher-involvement in the utterance of explanations: instances of EXPLAIN were performed either just by the teacher or, in most cases, as a combination of teacher and students.

5.6. EXPLORE (Hopf)

In her work approaching CLIL education previous to her article of 2013, in which she introduced her concept of CDFs, Dalton-Puffer already mentioned EXPLORE as an important discourse function, but at that time called it *hypothesize* (e.g. Dalton-Puffer 2007). Since her concept of CDFs was published in 2013, EXPLORE is part of the critical discourse functions in CLIL education and *hypothesize* has become, among *speculate, predict, guess, estimate, simulate* and *take other perspectives,* one of the members of this CDF (Dalton-Puffer 2013: 235).

Already in 2007 Dalton-Puffer (2007: 159) states the importance of EXPLORE by mentioning its appearance "among the core" in "discussions of thinking skills and academic language functions". Given that *hypothesizing* and *predicting* make use of rather complex language structures, EXPLORE is especially interesting concerning the study of second language use in content lessons (Dalton-Puffer 2007: 159). Also Vollmer (2010: 22), although calling it "searching (explorative function)", ascribes importance to this CDF by not only integrating it into his list of macro functions crucial to science teaching, but also placing it on the first rank.

If a definition of EXPLORE is searched for, the first step is to clarify if exploring or hypothesizing is understood in scientific terms or not. Dalton-Puffer (2007: 160) clearly states that she is only concerned with instances of EXPLORE, which are uttered in a semi-expert context and thus her definition is based on "non-technical terms". According to her, EXPLORE means "to make an assumption or prediction about what something will be like or would be like if certain conditions are met" (Dalton-Puffer 2015: 17). The facts which an exploration is built on links it to factual reality by describing possibilities or logically realizable future events but they are certainly not manifest. (Dalton-Puffer 2015: 17-18). Since this definition implies that the realizer of an exploration states something that is thought to be true under certain circumstances, the basic communicative intention of EXPLORE as summarized by Dalton Puffer (2013: 234) is "I tell you something that is potential".

For realizing this potential notion of EXPLORE, the writer or speaker has to use rather elaborate grammatical structures, mostly from the field of modality, which is considered to be a particularly complex aspect of the English language. The lexico-grammar of modality typically includes "modal verbs (*can, will, may* etc.), adverbs (*probably, perhaps, possibly, possibility*), conditional conjunctions (*if*) and lexical phrases" (Dalton-Puffer 2007: 160). Further Dalton-Puffer (2007: 160-161) provides the following two tables, presenting several verbs and phrases that might introduce hypothesizing episodes of language.

Table 10. Verbs and phrases introducing hypothesizing episodes adapted from Dalton Puffer (2007: 160-161)

introducing verbs	**introducing phrases**
assume	let's think/say/assume/imagine
guess	(so) what would happen (if)
hypothesize	what will happen if
imagine	what happens if
predict	can you predict
propose	what would your prediction be?
speculate	what would you propose
suggest	what would you do if
suppose	anyone wanna take a guess?

As the table shows, even words which are under most circumstances characterized by their neutral connotation like *think* or *say,* become markers of potentiality when appearing in a certain syntactic frame. Example 27 illustrates how the word *think*, embedded in an inducing phrase, is used to trigger an episode of EXPLORE.

Example 27. EXPLORE,

> T: **What do you think?** Ask yourself the following question; is it sex-linked or not…and, ahm…**what do you think?**
> Sf: Yeah, sex-linked.
> T: Why?
> Sf: Because only males are affected?
> T: Yeah. Or significantly more males are affected, right?
> Sf: Yeah.

A brief corpus analysis of MICASE (Michigan Corpus of Academic Spoken English) conducted by Dalton-Puffer (2007) revealed that the most frequently verbs and phrases, used for this purpose and found in the corpus, are *assume that*, *assuming that* and *let's say* (Dalton-Puffer 2007: 161).

The consequence of EXPLORE demanding rather complex grammatical structures seems to be that students and sometimes even teachers tend to avoid this CDF (Dalton-Puffer 2015: 19). Generally speaking, a student realizing a CDF-episode without help or induction by a teacher is a rather rarely observed phenomenon. Probably owing to the fact that explorations do require the use of more complex language, students seem to be especially restrained regarding this CDF, causing realizations of EXPLORE only being apparent in teacher-realized instances or co-realized utterances by teachers and students (Dalton-Puffer 2015: 189).

Even though students encounter difficulties when they are supposed to utter explorations, this CDF is crucial to classroom talk, especially when it comes to science education. As mentioned by Kröss (2014: 31), there is a particular need for EXPLORE when conducting and discussing experiments in the Physics classroom, since in this context, students have the opportunity to "[…] predict outcomes, hypothesise about potential explanations, make guesses and estimations [or] simulate phenomena". Example 28 shows that this need for EXPLORE is also relevant in Biology lessons, as they too offer several opportunities for conducting experiments.

Example 28. EXPLORE, **experiment**

> T: So this experiment demonstrates diffusion, or the process of diffusion, which is a physic-, ah, a physical one. It's a physical process. And what can you observe? I think this is quite quick the, the tea, it's quite quick. Did I stir it?
> Sm1: No.
> T: No. But what happened to the, the tea, the substances within the tea bags? What did they do? [Sm1], what would you say? Are they still in the tea bag, [Sf]? Are the substances still in the tea bag?
> Sf: No…But I do not know how –
> T: At least some of them, not all of them, yes. Which substances travelled into the water? No specifics, I just want general answers.
> Sm2: Colour.
> T: Yes the colour, and maybe?
> Sf: The enzymes with all the other substances that are stored in the, ah, vesicle, ah, the vacuole in the plant cells, that the…
> T: Hm, oh that's a very sophisticated answer. Yes, it would be fine to say the colour of the tea, and not only the colour, because you also –
> Sm3: Taste.
> T: The?
> Sm3: The taste.
> T: The taste, yes.

Here we have an episode of EXPLORE articulated in co-realization of the teacher and several students with the purpose of hypothesizing about the effects of an experiment. The teacher encourages the students to share their thoughts, and in this way triggers the utterance of explorations.

Encouraging students to explore and to try out ideas, like illustrated by the previous example, is just as much a teacher's responsibility as evaluating and recasting their explorations. Students are supposed to explore discussed topics and take risks in the classroom context, since mistakes as well as success can induce productive learning (Wells 2009: 129).

Previous findings

Even though Dalton-Puffer's (2007) analysis of several CLIL lesson of various content subjects was expected to provide evidence for the discourse function EXPLORE, only a few instances of this CDF could be reported. Dalton-Puffer (2007: 168) ascribes this rarity of EXPLORE to lacking L2 competences on side of the students and states that linguistic structures required for the expression of probability are often avoided, even by students of a more advanced language level. Often teachers have to recast student-uttered explorations, which usually lack modality. Moreover, Dalton-Puffer (2007: 167) observed that the few instances of EXPLORE uttered by students were very short, which further reinforces the assumption that students show a rather reluctant attitude towards practising this CDF type.

Likewise, Kröss' (2014) results about EXPLORE point towards a generally limited amount of student-realisations of this CDF. Her set of data included teacher-realisations and co-realisation from students and teachers, but there was not one student-realised occurrence of EXPLORE present (Kröss 2014: 56).

5.7. REPORT (Hofmann)

The central function of reports is to fill an informational gap by **informing** listeners about a specific issue (Kröss 2014: 34). This matter may be external to the immediate context, that is, the report may be comprised of something not intrinsically related to the present situation. Dalton-Puffer's (2013: 234) communicative intention sums this up nicely: "I tell you about something external to our immediate context on which I have a legitimate knowledge claim". The REPORT category thus includes a variety of synonyms or near-synonyms, whose basic underlying function is the presentation of information of some kind: *report, inform, recount, narrate, present, summarize,* and *relate* (Dalton-Puffer 2013: 235). There has been some arguing as to whether *summaries* ought to belong in the category under inspection given its compacted nature (Gillet et al. 2009: 7), but due to its shared intention to convey information it is part of REPORT (Dalton-Puffer 2015: 20).

Reports about the findings or statements of a person other than the speaker; that is, in written contexts any kind of citation, always require a reporting verb to indicate the beginning of an author's, researcher's or scientist's borrowed 'property'. Hyland's (2004: 27) study on academic writing revealed that the most frequent reporting verbs in Biology are *describe, find, report, show, suggest, observe*. Such indicators are unlikely to appear in everyday verbal classroom interaction given their formal nature, but other less formal ones may be found, such as *say,* or *find out*.

Hyland (2004: 27) formulated three different reporting processes according to the format of activity they make reference to.

a. Research Acts
   reference to real-world activities
   examples: *observe, discover, analyse*
b. Cognition Acts
   reference to mental processes
   examples: *believe, suspect, view*
c. Discourse Acts
   reference to verbal expressions
   examples: *state, discuss, hypothesize*

Drawing on previous studies, Dalton-Puffer (2015: 20-21) states that oral reports in classroom discourse occur predominantly in three constellations, the first being in students' summaries of activities, which may be the starting point of a general discussion of the preceding pedagogical task, secondly, extended presentations from students, and thirdly, short teacher monologues designed to give an account of a matter related to the topic. The extracts in examples 29 and 30 are such brief teacher reports in the form of a Research Act and a Discourse Act, respectively.

Example 29. REPORT, **Research Act**

> T: he basically **discovered** that there must be evidently some kind of a difference between the phenotype and the information which is actually stored some...somewhere in the organism. And this information is called genotype.

Example 30. REPORT, **Discourse Act**

> T: he **said** the following, he said the following, well actually there must be two factors present. And he now did the following, he now decided that uh we have a purple crossed with white that's the P parental cross and the purple he now **said** the following. We have big P, big P, crossed with little p, little p.

Research Acts and Discourse Acts can easily be distinguished from one another by the respective reporting verbs, the first example containing *discovered*, thus referring to an event where scientific research in some form took place, and the latter *said*, expressing someone else's statements.

Widdowson (1979b: 52) focuses on the report of series of events in particular and notes that they include the presentation of two types of information:

a) the event (what happened)
b) the time of the event (when it happened).

In terms of localizing events on a time line, he distinguishes between four possibilities, which can be seen in table 11.

Table 11. Reports of series of events, adapted from Widdowson et al. (1979b: 52), examples with original emphasis

Tense	Function	Example
present progressive	emphasis on the present situation	Countries *are building* nuclear power stations.
past simple	completed event on a particular point of time	*In* 1919 Rutherford *split* the atom.
present perfect progressive	emphasis on a time span up to the present	Since 1942 atomic energy *has been used* for peace and war.
present simple	statements of general validity	Fission *releases* energy.

The above four tenses are mainly used to report on series of events, their application depending on the temporal dimension within the event occurs, or has occurred, and on the relation of the event to the presence.

A further distinction that is to be made with regard to REPORT is the difference between *reporting* and the neighbouring rhetorical function *narrating*. While reporting is an action oriented outwards to a listener or a group of listeners, its content being objective, narrations are turned towards the interior and display the subjective viewpoint of the speaker towards the matter under discussion (Dalton-Puffer 2015: 21). Having said this, a comment on the practice of this theoretical distinction is required at this point. A clear-cut classification of passages as reports or narrations is not always easy, especially in oral communication, owing to the fact that the speaker may not always be aware of, or deliberately following, the type of discourse his or her string of speech is, or is supposed to be, located in. Lemke (1990: 108) distinguishes narratives from causal explanations by their chronological sequence and their aiming at a climax instead of a logical conclusion. Accordingly, they are used by teachers to tell anecdotes, stories, and jokes. Examples 30 and 31 aim to outline the basic communicative difference of *narrating* and *reporting*. Subjective and personified phrases are presented in bold, so as to highlight their prevalence in the first example.

Example 30. REPORT, **(personal) narration**

> T: ja the story goes like this uh we had uhm uhm **I heard of this, I was not part of the whole story** but my, **we had a dog** uhm a female dog who was like kept in the house and **my father said** many many many years ago, 'okay actually it would be nice also for the distant family, they have also dogs', so he took the dog to a a dog breeder, and uh to get the dog inseminated. And then indeed after some time there were the baby dogs here and at birth **I think** two of them died uhm one of them never barked at all, dog that never barks...No, he was just hanging around, the guy, it was totally mute, he couldn't, he couldn't, he couldn't make sounds, okay? And **I think** the other one, the other dog that survived basically, yeah also was **a bit strange**. And uh this **was actually not fine, because the whole thing costed, costed money** and then ??? turned out that there was a kind of was **a little bit sloppy** and that actually the dog,

> the female dog, **our female dog** turned out, was inseminated with the sperm of her own father.

Example 31. REPORT, **(scientific) report**

> T: when bacteria enter the body for example, or viruses, yes, ah, the immune cells of the body, the white blood cells, recognise whether they belong to the body or not. Sometimes, in auto-immune diseases or disorders, ah, what happens there? There's something wrong with the immune systems…So, **they think** that own body cells, ah, don't belong, so they start to fight them.

Example 30 is a narrative story, as suggested by Lemke (1990). Note that the report in example 31 also contains a personalised construction (i.e. white blood cells do not *think*), despite its generally scientific nature.

Previous findings

Kröss' study (2014: 48-56) suggests a rather unequal distribution of the CDF type REPORT amongst different lessons, in some instances making up the most common discourse function, whereas in others they seem of minor importance. It is likely that the different teachers and their preferred methods and pedagogical styles are a pivotal factor for such an irregular distribution. As concerns the realisations of REPORT, it has been found that teacher-student realisations occur more than twice as frequently as realisations made solely by the teacher.

5.8. Meta-talk (Hopf)

Given that this thesis also takes into consideration meta-talk about the seven CDFs, uttered by either teachers or students, there is a need for clarifying what is understood by the term *meta-talk* and how it contributes to the use and integration of CDFs in a CLIL environment.

Since no significant theoretical or empirical research on meta-talk dealing with CDFs in particular has yet been carried out, this chapter can only draw on meta-talk research from adjacent fields relevant for the study of CDFs. While mainly consulting studies concerned with language learning and linguistic meta-talk, e.g. Hu (2011), Basturkmen et al. (2010) and Mohammed (1996), additionally insight provided by work on subject-related meta-talk, e.g. Lemke (1990), will be included. Although these studies do not address meta-language in particular relation to CDFs, their findings can be used as an analogous source of information.

"Metadiscourse is talk about talk" is the very straightforward definition of meta-talk which Lemke (1990: 118) provides concerning this issue. Hu (2011: 180) further states, that the "terminology used to analyse or describe language" can either be of a technical or semi-technical nature. Therefore meta-talk is not exclusively found in academic language but also part of our everyday speech repertoire. Whenever we are not simply saying or doing things, but also simultaneously commenting on these things, meta-language is used (Lemke 1990: 118).

As declared by Hu (2011: 180), who concentrates on a language learning perspective on meta-talk, the rise of CLT (Communicative Language Teaching), which sets greater value upon communicative competences than formal language knowledge, caused the stigmatisation of meta-talk. Especially due to its close linkage to formal grammar, the use of meta-language in the CLT context diminished (Hu 2011: 180). Mohammed (1996: 283) for instance, draws attention to the additional learning burden which might emerge from teaching meta-language and claims that it does not influence the way language is actually processed. In opposition to these negative attitudes towards meta-talk, Hu (2011: 181) strongly defends the importance of meta-language regarding the L2 context and underlines its potential benefits. As he points out, based on the findings of more recent empirical research it can be argued that knowledge about meta-talk correlates positively with L2 proficiency levels (Hu 2011: 181). Particularly the correlation of meta-language and meta-linguistic knowledge appears to be of great advantage for learners (Hu 2011: 181) since, like Ellis (2004: 240) puts it, "access to linguistic labels may help sharpen understanding of linguistic constructs".

Alongside other factors regarding language learning, Hu (2011: 181) mentions that meta-lingual terms might prove advantageous when new structures need to be linked to formerly acquired language knowledge. This issue might be of special interest for consciously teaching and acquiring the use of CDFs in class, since they are often realised by applying special linguistic structures. Discussing the CDF EXPLORE for example, it was mentioned that for uttering a proper explanation, the realiser needs to draw on his knowledge about grammatical structures like modality (Dalton-Puffer 2007: 160), meaning that already acquired knowledge has to be activated and put into practise. Meta-talk might just be the right instrument to actively discuss and practice CDFs in class, and might furthermore help learners to connect these new concepts to their existent language skills. Based on these considerations we expect meta-talk to be applied when the proper use of CDFs is taught and practised and that it might trigger their active and conscious implementation in classroom talk. An analysis of its actual realisation in the eight recorded lessons will be discussed in the course of the quantitative and qualitative analysis of this language feature.

Focusing on linguistic structures in language education involves concentrating on form. Like stated by Basturkmen et al. (2010: 1), learners of a foreign language often have problems with focusing on form and meaning simultaneously. Further, methods which support processing meaning in context may not be helpful for the development of linguistic competences, which is why "form-focused instructions" are needed to compensate for this lack (Basturkmen et al. 2010: 1). Basturkmen et al. (2010: 2) point out that a special focus on form can be achieved by using meta-talk about linguistic structures. They conducted a study in an intermediate, as well as a pre-intermediate English classroom in New Zealand to investigate meta-talk in an EFL context. The data generated by their study revealed that potentially meta-talk might be uttered *pre-emptive* or *reactive* to a sequence focusing on form with the former option occurring more frequently (Basturkmen et al. 2010: 11). The following two examples illustrate how meta-talk can be used to discuss CDFs in a pre-emptive (31a) or reactive (31b) manner.

Example 31. Meta-talk, **pre-emptive and reactive meta-talk**

a. T: **And I'm to now label them** a little bit so that you understand what the parts are called. (meta-CLASSIFY)
b. 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.** (meta-DEFINE)

Besides combining already acquired and new linguistic knowledge and placing focus on form, there is another purpose of meta-talk, which might also be considered important for the classroom context. Lemke (1990: 118) mentions that boundaries to distinguish separate activities can be set by using meta-language. Example 32 provides exemplification of this special situation.

Example 32. Meta-talk

> T: The next example is now going to be one of a dominant condition. Huntington's disease. **Which I'm going to explain**. So; that is basically over here what you already know, and now let's talk about Huntington's.

Using meta-talk, the teacher announces that he is going to utter an explanation and simultaneously he indicates that a new topical area is going to be entered.

Of course, potentially meta-talk could be used by both, teachers and students to approach linguistic and formal issues but as Basturkmen et al. (2010: 11) reported, based on their study, it is teachers rather than students who draw on this linguistic resource. Interestingly, a positive relationship between student-realised meta-talk and language uptake is also described by Basturkmen et al. (2010: 11). The observed enhanced uptake might be explained by the precision linguistic issues are addressed with when meta-language is used. Unfortunately, student-realised meta-talk occurs definitely less frequently than teacher uttered instances (Basturkmen et al. 2010: 11) and thus might be considered to be a useful resource for language learners, which until today appears to have mostly remained unused.

Regarding the analysis of meta-talk, problems are expected to occur concerning the amount of data provided by the study, since prior work in this field showed that meta-talk seems to be a rarely occurring phenomenon in classroom talk. Referring to this issue Lemke (1990: 118) states, that meta-discourse can potentially be part of approaching certain themes but that it is actually barely applied. By way of explanation he notes 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). Similarly Dalton-Puffer (2013: 240) points out, that teachers on the one hand demonstrate their knowledge of CDFs in class but they most often do not address or explain how these functions are used.

Previous findings

As part of his study, Lackner (2012) analysed meta-talk regarding four of the seven CDFs discussed for this current thesis, occurring in a CLIL environment. He comes to the conclusion that metadiscourse as a part of history CLIL lessons is an almost inexistent phenomenon (Lackner 2012: 60). Although most instances of meta-talk observed in this context were of rudimentary quality, Lackner (2012: 104) stresses the occurrence of two interesting examples. These two instances of meta-talk, concerned with DEFINE and DESCRIBE, were both uttered with reference to upcoming testing situation, which according to Lackner (2012: 104) indicates that the teacher ascribes a certain importance to these CDFs.

6. Study design

This chapter first presents our research questions, before outlining the methods, technical equipment and software used for data collection and processing. In a further step a list of codes that were tagged to our lesson corpus will be discussed, and a brief overview of our data in terms of lesson topics, key terms and noticeable characteristics of the class will be provided to give insight into the environment of our data collection.

6.1. Research questions (Hofmann)

This study aims to shed light on the nature of cognitive discourse functions in the CLIL Biology classroom. Much research has been conducted about academic language functions in written contexts, but the number of studies devoted to oral communication in didactic contexts are limited. It is our hope that the results will feed into a pool of insightful data which may support the idea that CDFs are of pivotal importance in bridging the gap between language and content in the CLIL classroom. This study will address the quantitative distribution of CDFs, as well as some qualitative aspects, like frequently encountered sub-types and their characteristic forms and functions, the question of authorship, their immediate context and embedding in the didactic and thematic levels of the lessons, as well as the relationship between them. As such, this paper strives to answer a series of questions:

1) How frequently do the seven CDFs, as well as instances of meta-language, occur?
2) Who is the main realiser and why?
3) Which sub-types of CDFs can be identified and what are their main characteristics and functions?
4) How do individual factors, such as the lesson topic, the teacher, the kind of activity, the students, the school type, ect…influence the use of CDFs?

These sets of questions will be attempted to be answered in the course of a quantitative and subsequent qualitative analysis of the discourse functions and meta-talk. The main results of both analyses will be provided in the form of a concluding statement formulating answers to each of the above four questions.

6.2. Data collection and methodology (Hofmann)

Eight CLIL biology lessons were videotaped and recorded with two audio channels so as to assure maximum intelligibility of the spoken teacher-student interactions and thus facilitate the transcription process. For the audio channel H2next recorders were used, which are equipped with two channels which can be activated simultaneously in the surround-mode: the Mid-Side mode (MS) records sound waves coming from a right angle with a mid-microphone, as well as waves from both sides via a dipole-microphone. The MS mode allows for recordings in ample and open rooms. The Stereo mode (XY) records at a 90° angle and the loud speakers are located on the other side of the recorder. They are ideal for recordings in a close-up range as is the case for solo-artists or interviews. Both these modes were activated in the Surround-mode. The recorder was usually placed on the teacher's desk, making both close-up recording of the teacher in the XY mode and recording of students' talk in the far range with the MS mode possible. The video camera was situated so that the teacher and the blackboard were visible, which meant that some students sitting in the back of the room could not be filmed.

For transcriptions the recordings of each lesson were available three-fold with very different sound qualities. The videotapes were quieter in comparison to the audio records, but realisers' mouth movements were useful in some situations to decipher single words that were unintelligible in the audio-records. The MS mode records were best for transcription of students' talk, while the XY mode records obtained best results concerning teachers' talk.

All the same, difficulties during the transcription phase could not entirely be eliminated and many passages needed several rounds of listening before single words could be deciphered. Especially students' talk was hard to understand as many have the habit of speaking quietly or mumble their answers to evade teacher evaluation. Additionally, the acoustic environment in some rooms was unfavourable for recording, especially the science and laboratory room.

The lessons were transcribed by means of basic transcription conventions due to the fact that parameters such as intonation, stress and minor pauses are not part of this thesis and thus will not alter the outcomes. First names of students were omitted to ensure anonymity and replaced by a simple coding system taking into account the sex and the number of the student in order to ensure differentiation between them in dialogues involving more than two persons.

T…teacher
Sf1…student, female, number 1
Sm2…student, male, number 2

The finished transcripts were then imported into ATLAS.ti7, a computer software which facilitates the coding and management of extensive amounts of data. For this thesis the free version was downloaded and installed as it was sufficient for our purposes. ATLAS.ti7 enables the user to establish simple codes which can later on be analysed according to their quantity, quality and distribution. For the distinction of sub-categories of CDFs additional sub-codes were added, so that a transcribed passage is identified as belonging to one of the seven main cognitive discourse functions, (e.g. 'DEFINE') as well to one or more types of sub-categories, if any (e.g. 'translation', or 'nominal' + 'simple' + 'non-formal'). As eighth additional main group the type META-TALK was introduced to code all CDFs appearing in a meta-language context. All in all the transcribed material contains 45 different main codes and sub-codes, a list of which can be seen in table 12.

6.3. **School types** (Hopf)

The two schools visited for collecting authentic material for this study both participate in different programmes that promote multilingual education. One of the schools is part of the Viennese school pilot project *Vienna Bilingual Schooling* (VBS) and the second school is one of the 10 Austrian IB schools, participating in an international education programme which offer preparation for the *International Baccalaureate* (IB). In order to depict the general formal framework in which the eight observed CLIL Biology lessons took place, the following chapter aims to shortly introduce both projects.

International Baccalaureate (IB)

The International Baccalaureate is an educational foundation, founded in 1968, which offers four types of programmes in three different languages (English, French and Spanish), that aim to educate learners of varying age groups all over the world. Schools willing to provide one of these programmes have to be authorized by the organisation to become an IB World School (http://www.ibo.org/).

The organisation's mission, as stated on their official website (http://www.ibo.org/en/about-the-ib/mission/) reads as follows:

> The International Baccalaureate® aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect. To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment. These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.

One of the schools visited for this study offers the *IB Diploma Programme* in English for year 2-4 of upper secondary (grade 10-12). This assessed programme can, as the name already suggests, be graduated from with an international diploma degree, recognized by most universities worldwide (http://www.ibo.org/en/programmes/diploma-programme/what-is-the-dp/). To prepare students for this programme from the first year on, the language of instruction in the visited school is English. Students of years 10-12 in upper secondary all participate in the *IB Diploma Programme* courses, but since the IB is only understood as an opportunity provided for students, not everybody is obliged to take the final diploma exams. However, regardless of whether students decide to take the exams or not, every student still has the opportunity to take the Austrian Matura exam at this school.

Vienna Bilingual Schooling (VBS)

The second school we visited for collecting material is one of several schools participating in a Viennese school pilot project called *Vienna Bilingual Schooling (VBS)*, which started in 1994. According to the *Stadtschulrat* (educational authority) of Vienna, the purpose of this project is to offer primary as well as secondary education by means of both, the German and the English language. The conducted lessons are supposed to comply with the Austrian curriculum and further aim towards an education in a second language (either English or German) which reaches beyond the aims of common language education (http://www.stadtschulrat.at/bilingualitaet/catid18/).

6.4. Data overview (Hofmann)

The eight CLIL lessons were recorded in two upper secondary classes in different schools, one in Upper Austria and one in Vienna. The two teachers conducted four lessons each, which lasted approximately 45 minutes on average. In lesson A2 we were asked to introduce ourselves and briefly give the students an outline of our academic career, which eventually expanded to a quarter of an hour report on different matters about university and academic studies. T2 was the class' homeroom teacher, which entailed a variety of organisational affairs at the beginning of three of the four lessons, particularly in the last lesson before and the first lesson after the Christmas holidays. In sum, the eight lessons yielded 96 pages of transcript, which makes an average of twelve pages per lesson.

What follows is an overview of the students' profile of the two different schools. The school types, which will briefly be outlined in a subsequent section, as well as classroom policies may have had an influence in their behaviour and, by extension, may have helped shape the landscape of CDF use in both classes.

Table 12. Overview of students' profile

Class of teacher	Number of students	Grade	Age	Comments
T1	16 (10m, 6f)	12th	17-18	The number of students indicates that this class was fairly small; the reason for this is that the observed lessons were from the IB programme and not from the 'core' curriculum. Since not one student had in mind to do the IB exam at the end of the year, some tended to drop out of classes frequently.
T2	25 (9m, 16f)	9th	14-15	This was a so-called 'lap-top class'; many students were using electronic devices to take notes, access previous handouts or look up specific information in relation to the topic. The teacher started each Wednesday's lesson (B2, B4) with a review for which students could volunteer in exchange for a 'Mitarbeitsplus'

The overall topic of T1's lessons was Mendel genetics, which deals with the inheritance patterns discovered by Gregor Mendel in the middle of the nineteenth century. Related issues are the inheritance of blood-groups as an example of multiple alleles and co-dominance. Another issue that is usually addressed in relation to classical genetics is the inheritance pattern of sex-linked conditions. The general topic in T2's lessons was transport of substances across bio-membranes. The differentiation between diffusion and osmosis, as well as active and passive transport is a common sub-point of this area of expertise, along with the mention of classes of molecules and the structure of the lipid membrane.

Table 14 is an overview of the general thematic units covered by the teachers of the two classes, along with a list of related key-terms.

Table 13. Overview of topics and key-words per lesson

Lesson	Teacher	Topic	Key words
A1	T1	introduction to Mendel genetics	genotype, phenotype, allele, gene
A2	T1	monohybrid crosses	homozygous, heterozygous, dominant, recessive, factor, ratio
A3	T1	inheritance of blood groups	multiple alleles, codominance

A4	T1	inherited conditions	sex-linkage, X-chromosome
B1	T2	transport across membranes	role, transport, active, passive, ATP
B2	T2	diffusion	semi-permeable, molecule
B3	T2	factors for rate of diffusion	energy, heat, gradient, size
B4	T2	osmosis	water, solute, solvent, vacuole

6.5. Making predictions (Hofmann)

The topics treated by the two teachers proved to be very distinct from one another (see table 14), which may have a significant influence on the results on CDFs their lessons will yield. The overall content of T1's lessons was Mendel genetics and of T2's lessons transport of substances across membranes.

At this point a question that intrigues us is whether it is in fact possible to make realistic guesses about the quantitative distribution of CDF types considering only the different nature of the topics that have been covered throughout the two lesson quartets. In other words, can predictions about the quantitative distribution of CDF types be made on the basis of our knowledge as teachers-to-be about the general thematic and didactic realisations of the two overall topics? Below follows a list of our predictions, first about T1's lessons and secondly about T2's lessons, and the individual CDFs whose quantitative representation we consider predicable. The answer to the question as to whether such predictions prove worthwhile can of course only be provided after the quantitative analysis.

6.5.1. Mendel genetics

The four lessons A1-A4 taught by T1 covered most of what is known as Mendel genetics. A major part of Mendel genetics is the work with genetic test crosses with the purpose of calculating the probability of certain inheritable characteristics to be passed on to the next generation. Frequent sub-topics are Mendel's pea plant experiments, dominant and recessive inherited conditions, sex-linked conditions, as well as the inheritance of the blood groups.

Hypothesis 1) CLASSIFY

Lessons A1-A4 will contain many classifications: Mendel genetics contains many binary opposite terms (e.g. *phenotype* and *genotype*), which are classes where a variety of hyponyms belong in. These hyponymous terms need classifying into the corresponding classes.

Hypothesis 2) DEFINE

Lessons A1-A4 will contain many definitions: Mendel genetics introduces a group of new topic-related scientific terms which need clear and structured defining in order for the students to understand minor but crucial differences between them (e.g. *allele*, *gene*). Most new terms are binary opposites of one another (e.g. *homozygous* and *heterozygous*), which makes a comparison likely.

Hypothesis 3) DESCRIBE

Lessons A1-A4 will contain few descriptions: Mendel genetics is a field where any kind of process, be it biological, physical, or chemical, is of little importance. It is not about step-by-step procedures which lead to an end result, neither does it broach the physical characteristics of any biological structures (an exception might be the comparison in shape and size of the female and male sex-chromosome).

Hypothesis 4) EXPLAIN

Lessons A1-A4 will contain many explanations: identifying the genotype or phenotype of a generation usually requires an explanation in terms of the heritance of another generation, for instance *so consequently, the father must either have 'AB' or 'AO'*, or *the child is affected because both parents carry the dominant allele*. Due to the fact that doing test crosses is an important activity, such explanations will often arise.

Hypothesis 5) EXPLORE

Lessons A1-A4 will contain many explorations: doing test crosses in Mendel genetics will probably involve the formation of students' hypotheses about results. Concerning the inheritance of blood groups the teacher might request students to draw conclusions about the genetic profile of the parents, deduced from the genotype of the child. As such, we would even describe the nature of Mendel genetics as primarily exploratory.

6.5.2. Transport across membranes

In the lessons B1-B4 conducted by teacher T2 the main content was transport across cell membranes. The topic usually involves the differentiation between various kinds of transport, such as osmosis, active transport, or diffusion. Other themes are the purposes of transport in and out of cells, the kind of energy needed (ATP[1]), as well as the structure of a biomembrane and types of molecules that are transported across.

Hypothesis 1) CLASSIFY

Lessons B1-B4 will contain few classifications: in transport across membranes few scientific terms maintain a hierarchical relationship to each other, that is, constitute a class and its members. There might be a handful of exceptions, like the type of molecules able or unable to diffuse through membranes.

Hypothesis 2) DEFINE

Lessons B1-B4 will contain many definitions: as with all new topics, also transport across membranes brings up a range of new scientific terms which need defining (e.g. *diffusion*, *solute*). In contrast to Mendel genetics, the new terms are semantically more easily distinguishable from one another and will therefore not generally be compared.

Hypothesis 3) DESCRIBE

Lessons B1-B4 will contain many descriptions: any type of transportation across cell membranes is a process, which puts the step-by-step description and by this the distinction between the types under analysis in the foreground. Additionally,

[1] ATP: Adenosine Triphosphate, an organic compound which provides energy for cellular activities by hydrolysis of one of its three phosphates; it is the main source of chemical energy in all living organisms

cytology is concerned with the description of a cells' parts, as well as the structures it interacts with. For this reason physical descriptions will occur to provide necessary information on specific parts or structures of cells, molecules and bio-membranes.

Hypothesis 4) EXPLAIN

Lessons B1-B4 will contain many explanations: being closely interrelated in their function and environment with process descriptions, explanations of causality relationships between two or even more circumstances will occur. Especially with regards to transport, explanations as to the cause and origin of the movement will be provided (e.g. *a high salt concentration on the outside causes water to diffuse out of the cell*).

Hypothesis 5) EXPLORE

Lessons B1-B4 will contain few explorations: The topic transport across cell membranes puts emphasis on describing the processes and individual stages involved, but does in its nature not provide much room for hypotheses or exploratory work. As such, there will be few tasks the teacher can set to make the students speculate on, guess or predict outcomes, implications, reasons, etc…

6.6. Code overview (Hofmann)

The table below shows all codes which have been created in the ATLAS.ti7 programme and selectively attached to the identified CDF passages of our transcriptions.

Table 14. Overview of codes

Main Codes	Sub-Codes		
CLASSIFY	open	closed	
	complete	partial	implicit
DEFINE	real	nominal	
	simple	complex	
	formal	non-formal	semi-formal

	explication	stipulation	operation	
	translation			
DESCRIBE	physical	structural	functional	process
EVALUATE	difficulty	certainty	importance	
	justify-ev			
EXPLAIN	causality	consequence		
EXPLORE				
REPORT	research	discourse	unspecified	
Meta-talk	meta-cl	meta-def	meta-des	
	meta-ev	meta-ea	meta-eo	meta-rep
	meta*			

The codes in table 1 are displayed as follows: the capitalised and bold codes in the left column are the eight main codes, comprised of the seven cognitive discourse functions as well as the category 'meta-talk'. On the left hand side is a list of all sub-codes, which are grouped together with their corresponding main code on the right hand side. Evidently some main codes comprehend a large variety of sub-codes, whereas EXPLORE is not comprised of any sub-type at all. Some main codes, namely CLASSIFY, DEFINE and EVALUATE, contain sub-types on several different criterial levels. Members of the same criterial level are within the same horizontal line, such as the distinction of open or closed classifications. An exception is the list of sub-types of meta-talk, which all belong to the same criterial category but are listed in three rows due to formatting issues.

The sub-types of criterial levels are in many cases binary opposites, that is, a classification is either closed or open, or a definition is either real or nominal. In other cases there are three or more sub-types within a criterion, such as the four types of descriptions. A phenomenon that the table above does not demonstrate is the fact that some categories are relevant only in combination with another category, that is, an occurrence of DEFINE does not always possess six different codes (the main code and one from each of the five categories of sub-types). To be precise, the category which contains the sub-types 'explication', 'stipulation' and 'operation' is only significant if the definition is coded as being 'complex' in the category describing complexity, whereas the category whose members characterise the range of formality is only relevant in combination with simple definitions.

Three sub-types have been highlighted with light-grey backgrounds; these are codes that have been added by us due to their need which arose during the primary coding process. In the case of EVALUATE we discovered the close link between real evaluations, which always entail a justification, and instances of judgments without such justifications, a fact which called for the need of a code to differentiate between these closely related cognition acts. During the coding process of REPORT, meanwhile, a great variety of occurrences neither being 'discourse' nor 'research' reports have been identified, which were coded 'unspecified' in a first step, and further classified into sub-types during the qualitative analysis. Finally, instances of meta language have been sub-coded according to whichever of the seven CDF types they address on a meta-level. The code with the asterisk marks all occurrences of meta-language with special 'profoundness', that is, with an elevated degree of language reflection, regardless of the CDF type.

6.7. The realisers (Hofmann)

A further dimension represented as codes in the ATLAS.ti7 files are the realisers, that is, who is responsible for the utterance of a CDF. There are three different types of realisations: one or more students, coded with an 'S', the teacher, coded with a capital 'T', and a combination of both, teacher and student(s), coded with a capital 'TS'. Clearly it is not in the nature of the latter code, 'TS', to provide information about the degree of participation of the teacher and the students. In other words, as soon as a passage contains a verbal exchange between the teacher and his or her students, it will be coded 'TS', disregarding the degree of involvement of either. It is thus not guaranteed that a TS-realised CDF passage is verbalised by the teacher and his or her student(s) to the same extent, much more likely are cases where the teacher provides the majority of the input and students do little more than answering questions with minimalistic expressions. The code 'S' was only added to CDF realisations which were exclusively carried out by one or more students, that is, without any involvement of the teacher. As such, the number of S-realised passages will logically be rare, as the teacher usually does an extensive amount of correcting and triggering.

6.8. Adaptations and limitations of the analysis (Hofmann)

Research studies on *cognitive discourse functions* in the CLIL science classroom are still thin on the ground due to their very recent birth through Dalton-Puffer's first formulation in 2013. Due to this circumstance also methods for CDF extraction, classification in sub-types, as well as their descriptions and functions remain largely untested and therefore still need the test of successive trials. Bearing this in mind, it was our great ambition to standardise our own applied methods to achieve maximal consistency and transparency.

What follows is a list of adaptations which have been undertaken in order to guarantee precise work and accurate results.

German passages

The recorded lessons were comprised of natural classroom talk, which entails, of course and to different extents, the use of the students L1, that is, German. These passages were always transcribed for consistency issues, but never coded. As the study aims to shed light on the nature of overlap between foreign language and content, clearly passages in German are not part of its area of speciality. One particular type of translation has been taken into account in this study, though, because it has shown to yield interesting results in Kröss' data analysis, namely the translation of new technical terms into synonyms in German. These instances belong to the CDF category of DEFINE as they are cases of non-formal definitions through their synonymous relationship.

Episodes

CDFs do not necessarily occur isolated from each other. In fact, Kröss' study has shown that such academic language functions usually appear in clusters, that is, a larger passage is made up of one general function, which for her were the 'real' CDFs, which may again be comprised of different, smaller CDF *moves*, as she called them. During our coding process we realised that many CDFs, however, occurred independently of such clusters. With the intention in mind to grasp also these instances, we treated as 'real' CDFs what Kröss regarded as moves, and the larger passages involving smaller CDFs we called *Episodes*.

Theory of written CDFs to practice of oral CDFs

In the previous chapters that introduced the theory on the seven different CDFs it became evident that the vast majority of secondary literature unfurl the nature of the CDFs in written contexts, that is, in the case of didactic literature on textbooks. This represents a zone of conflict, as the direct and unadapted adoption of theoretical concepts of CDFs in written contexts into the analysis of oral instances of classroom talk did not always work smoothly: the CDF categorisations and sub-types presented in the theory were designed to characterise written language, and proved at times insufficient for the description of our oral instances. For this reason the distinctions and characteristics that were introduced in the theory are to be treated with caution, as they do not always truly reflect the nature of CDFs in oral language as precisely as in written language. What is more, spontaneous oral communication, especially when speakers unfamiliar with the scientific content are involved, that is, students, is naturally less accurate in its targeted use of language, a circumstance which again distinguishes the nature of CDFs in written and oral contexts. What has previously been pointed out and what results from this incongruity is that some new codes were added to the ones adopted from the secondary literature in order to compile a set of codes more apt to characterise spoken interaction (see the codes highlighted with light-grey backgrounds in table 12).

S-S conversations

Also the technical limitations need addressing at this point. Despite our endeavour to grasp all classroom talk by installing a video camera and a high-quality recorder and increasing the quality of the records even further on the computer, the instruments failed to grasp low-voice conversations between students. Due to general quietness and unintelligibility of most S-S talks (because often not discussing subject matters but private ones) these were not included in the corpus. The great majority of these cases were in the students' mother tongue, anyway, but there would have been one nice scene where the teacher sent students into pairs to hypothesise on the outcome of an experiment, which could have yielded interesting insights in their use of CDFs when not monitored by the teacher. What has to be said at this point is that further studies concerning student group-work are clearly required.

Informative value

This study aims to analyse cognitive discourse functions in as precise a manner and as consistent a method as possible in order to yield results with a high level of significance and to ensure that these results may also be safely reused for future studies. Despite these efforts what has to be considered is the very limited amount of data providing the foundation on which our analysis builds on: our eight CLIL lessons alone yielded an enormous amount of data information which has led to the formulation of a series of valuable insights about their internal structures, about sub-types and their functions, about CDFs' embedment in classroom conversation, and many more. Even endeavours to formulate sets of general rules and trends concerning the individual CDFs have been made. Nevertheless, these rules and trends and generalisations have been based only on the very limited data of eight lessons, which is why extensive further research will be needed in future to reformulate, revise and probably also refute some of our inferences. After all, the analysis, as thorough as it might be, of only eight lessons of no more than two teachers from only two different schools, can provide absolute information neither of teachers' methods, nor of students' abilities, nor of the exact nature of CDFs, nor of their implication in the CLIL science classroom. The ambition of this study is, in conclusion, to use the limited information it has it its disposal as effectively as possible.

7. Quantitative analysis

This first part of CDF analysis is concerned with the quantitative distribution of CDF types, as well as realiser, both across lessons and teachers. Furthermore, occurrences of meta-talk and longer CDF episodes will be a matter of discussion.

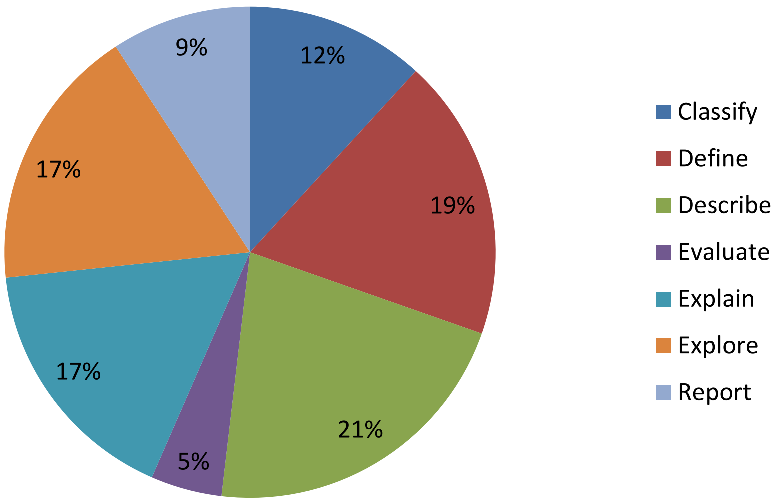
7.1. CDF types (Hopf)

This section provides a quantitative analysis of CDFs coded in all 8 observed lessons. Like Kröss (2014: 49) points out, the quantitative analysis of a certain set of data might clarify how certain factors influence the occurrence of CDFs. Potential factors of influence which can possibly be exspected in the course of a quantitative analysis are the nature of the different lessons (including varying methods and differences in terms of content) and the individual teaching style of the teachers in question (Kröss 2014: 49). In order to be able to provide conclusions of this kind, not only the general distribution of CDF types will be presented but also their distribution across different lessons as well as their distribution across the two teachers.

CDFs in isolation

Altogether the analysis of the data brought forth a total number of 619 CDFs uttered by students and teachers in eight CLIL lessons. The total number of CDFs distributed to the lessons observed yields an average of around 77 CDFs per lesson. Given that each lesson lasts around 45 minutes, the observed teachers and students uttered 1 to 2 CDFs per minute. Instances of all the seven CDFs postulated by Dalton-Puffer (2013) were observable, some of them with a higher frequency of occurrence, others in rather limited amounts. In figure 8 the occurrences of different CDF types in all eight lessons are presented as percentages.

Figure 8. Total numbers of CDFs as percentages



The most commonly used CDF is DESCRIBE (21%) followed by DEFINE (19%), whereas EVALUATE (5%), REPORT (9%), and CLASSIFY (12%) are the bottom three CDFs in terms of frequency of appearance. EXPLORE (17%) and EXPLAIN (17%) constitute the middle range, being realised almost equally often in the observed classroom discourse. The difference of only 12 percent between most and second least frequently used CDF can describe the overall occurrence of discourse functions in the analysed data as rather evenly distributed, with the only exception of EVALUATE.

CDFs across lessons

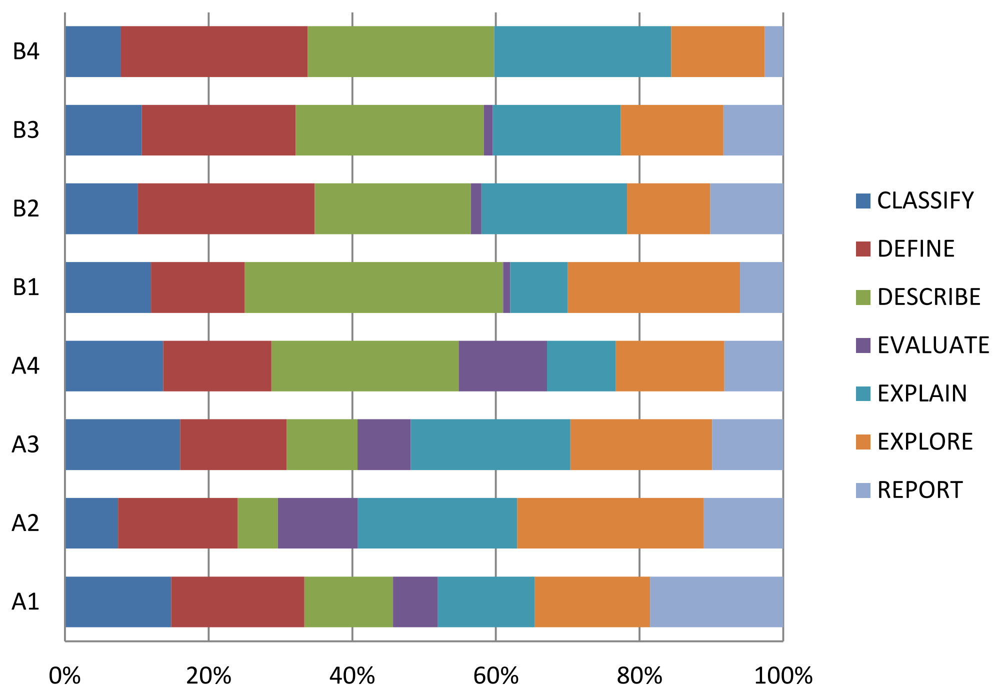
Taking a look at table 15 and figure 9, which illustrate the distribution of CDFs across lessons, slightly different results are observable. Certain CDFs which show high numbers of occurrence in the overall distribution of CDFs are rather under-represented in specific lessons.

Table 15. Distribution of CDFs across lessons A1 – B4

	A1	A2	A3	A4	B1	B2	B3	B4	**total**
CLASSIFY	12	4	13	10	12	7	9	6	**73**
DEFINE	15	9	12	11	13	17	18	20	**115**
DESCRIBE	10	3	8	19	36	15	22	20	**133**
EVALUATE	5	6	6	9	1	1	1	0	**29**
EXPLAIN	11	12	18	7	8	14	15	19	**104**
EXPLORE	13	14	16	11	24	8	12	10	**108**
REPORT	15	6	8	6	6	7	7	2	**57**
total	**81**	**54**	**81**	**73**	**100**	**69**	**84**	**77**	**619**

While table 15 presents the numbers of all seven CDF types performed in each individual lesson of the observation, figure 9 informs about the distribution of CDF types across these lessons as percentages.

Figure 9. Distribution of CDFs across lessons A1 – B4 as percentages



Although DESCRIBE is the most commonly used CDF in terms of total counts, there is a strong variation across individual lessons. Whilst DESCRIBE is the most frequently used CDF in lesson B1, accounting for around one fourth (36 instances) of all CDF instances, there are by far fewer realisations of DESCRIBE present in lesson A2 and A3, in which they only represents 5-10%. Similarly, DEFINE, which is the second most frequently uttered CDF in the overall comparison, and all the CDFs that are positioned in the middle field, show a rather uneven distribution across the eight individual lessons. This uneven division of individual CDF types across lessons results in different top used CDF types per lesson. While DESCRIBE (B1, B3, B4) and DEFINE (A1, B2, B4) appear three times as the most frequently realised CDFs, EXPLAIN (A3), REPORT (A1), and EXPLORE (A2) hold this position in only one of the lessons. Thus, although apparently there is an unequal distribution of frequently used CDFs across lessons, which is not consistent with the overall distribution of CDF occurrences, certain tendencies of similarity are observable. The CDFs DESCRIBE and DEFINE for instance, which show high frequency of occurrence in the overall distribution are also most often among the top realised frequencies in the comparison across lessons.

EVALUATE, CLASSIFY and REPORT are the three CDFs that proved to be least frequently realised when looked at in a general context. Similarly to the most commonly used CDFs, they do not hold this position in every lesson observed. The only property, when considering their distribution across lessons, that distinguishes them from generally more frequently used CDFs is that in none of the eight lessons, they obtain the position of most frequently used CDF. EVALUATE is the one and only CDF so infrequently verbalised that a search for occurrences in lesson B4 proved entirely fruitless, and in lessons B1, B2 and B3 yielded no more than a minimal total share.

REPORT might be seen as a rare part of classroom talk too, but actually this would rather be an unjustified and hasty conclusion. At this point it has to be mentioned that the graphs and numbers do not really present correctly the space occupied by REPORT in different lessons. Indeed, there are only a few instances in total counts of REPORT and in seven out of eight lessons it always occurs among the bottom three CDFs in terms of frequency of occurrences. Nevertheless, this discourse function is often realised in fairly long monologues which causes it to claim a longer share of classroom discourse than the apparent numbers might suggest. Since this is already an issue of qualitative analysis, further elaboration of it will be part of subsequent chapters.

In sum, the analysis of Table 15 and Figure 9 shows that although there is a slight tendency towards the preferred use or avoidance of certain CDF types (DESCRIBE and DEFINE / EVALUATE and REPORT) they appear to vary strongly across lessons. On the basis of these results, it might be concluded that the topics and methods shaping a lesson render differences in the use of CDF types and that cognitive discourse functions are by no means independent from different lesson structures.

The results found in the course of this analysis regarding the frequency of CDF realisations in eight different lessons are comparable to previous findings presented by Lackner (2012) and Kröss (2014). Both of them reported DESCRIBE to be the CDF uttered most often, while CLASSIFY, and EVALUATE in Kröss' data were always among the least frequently uttered functions. Owing to the concurrence of these two and, in some cases, three studies, although conducted in lessons of different subjects, it might be argued that tendencies towards the implementation of DESCRIBE and the avoidance of EVALUATE, CLASSIFY and REPORT in Austrian CLIL lessons are observable. Of course, further empirical data is needed to bring forward the necessary evidence to support this hypothesis.

CDFs across teachers

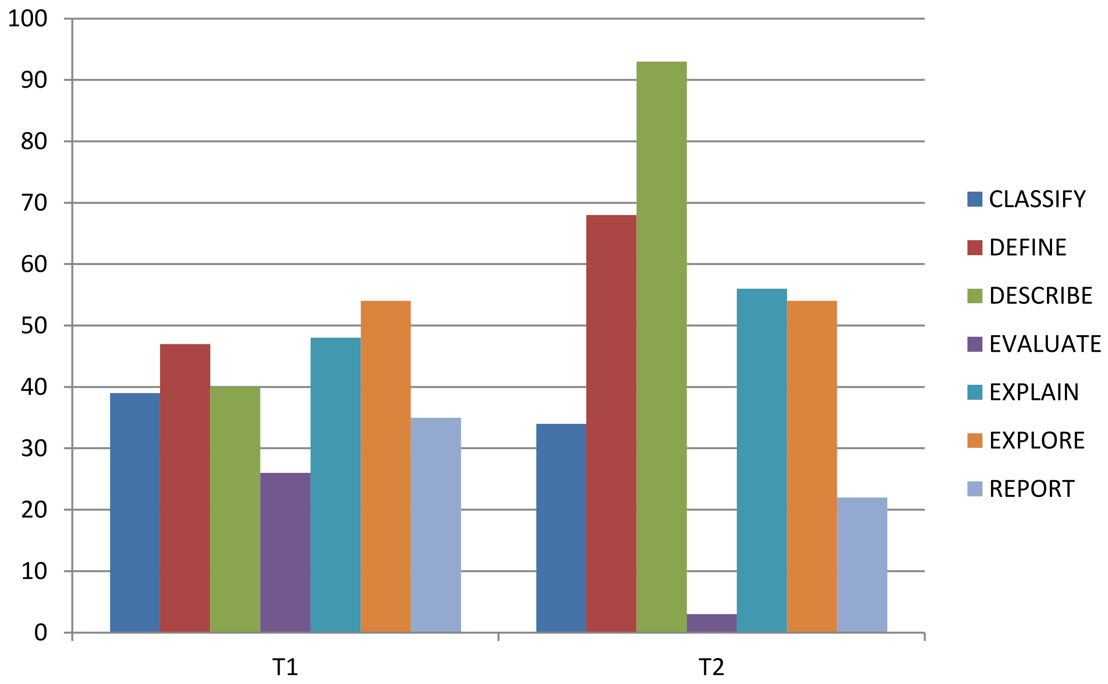
As mentioned before, not only the content of a lesson might favour the use of particular CDFs but also the individual teaching style has an influence (Kröss 2014: 49). To find out if this hypothesis holds true for the current set of data an analysis across the two teachers is conducted. Table 16 and Figure 10 present the distribution of CDFs across Teacher 1 and Teacher 2, totalling up all instances of CDFs occurring in four lessons each.

Table 16. Distribution of CDFs across teachers T1, T2

	T1	T2	**total**
CLASSIFY	39	34	**73**
DEFINE	47	68	**115**
DESCRIBE	40	93	**133**
EVALUATE	26	3	**29**
EXPLAIN	48	56	**104**
EXPLORE	54	54	**108**
REPORT	35	22	**57**
total	**289**	**330**	**619**

As Table 16 reports, the general numbers of CDF realisations during the lessons of the two different teachers are only slightly dissimilar, since the lessons of Teacher 1 featured 289 CDFs in total and 330 CDFs were involved in Teacher 2's lessons. While a comparison of the overall count of CDFs in the lessons of different teachers does not implicate great differences, the distribution of individual CDF types, like presented in Figure 10, reveals very interesting results.

Figure 10. Distribution of CDFs across teachers T1, T2



As illustrated by Figure 10, T1's lessons show a relatively even distribution of CDF types, with all realised CDFs ranging from 26 to 54 individual utterances per type. When looking at T2's lessons, on the other hand, there appear rather varied numbers of instances, ranging from 3 up to 93 individual utterances per CDF type. DESCRIBE and DEFINE are the most frequently used CDFs in Teacher 2's lessons, accounting for 45% of all CDF instances of these lessons. The least often occurring CDF is EVALUATE making up only three instances in the total counts.

The analysis of CDF distribution across teachers reveals that during two teaching sequences held by different teachers, CDFs might be used in very distinct manners. While the set of lessons taught by Teacher 1 include all CDFs in a rather balanced distribution, a preference towards the CDFs DESCRIBE and DEFINE is observable in Teacher 2's lessons. Although one cannot rule out the possibility that topics and methods used in these lessons create that distribution pattern, the individual teaching style is likely to also have an influence on the frequency of CDFs utterances.

On the basis of her findings, Kröss (2014: 51) suggests four hypotheses regarding the influence of lesson structures and teaching styles on CDF distribution. In the framework of her analysis the frequency of DESCRIBE and EXPLAIN both depended on the lesson, REPORT appeared to depend on the teacher and DEFINE seemed to depend on both, lesson and teacher. Even though some of her hypotheses are also valid in respect of this study, not all of them can be confirmed by the data collected.

Concerning the set of data analysed for this study, EXPLAIN is the only CDF that proved to be distributed equally among teachers but varied in terms of lesson distribution, which provides further evidence for Kröss' hypothesis about this CDF. Unequal distributions of DESCRIBE when compared across lessons as well as teachers, point towards an influence of both, which does not comply with Kröss' findings. EVALUATE and DEFINE appear to be teacher influenced since the irregularities in occurrences across lessons can be assigned to the different teachers. Although there are also slight inconsistencies across lessons, REPORT seems to be rather influenced by different teachers, which concurs again with

Kröss' findings. The remaining CDFs EXPLORE and CLASSIFY show rather stable and similar numbers in both distributions.

To conclude on the relevance of difference in lesson structure and teaching style it might be declared that there are some tendencies visible, even when comparing different studies. Nonetheless, the numbers are not significant enough and the collected empirical data too little, to make justified general statements about how teacher or lesson influences the frequency of which CDF types.

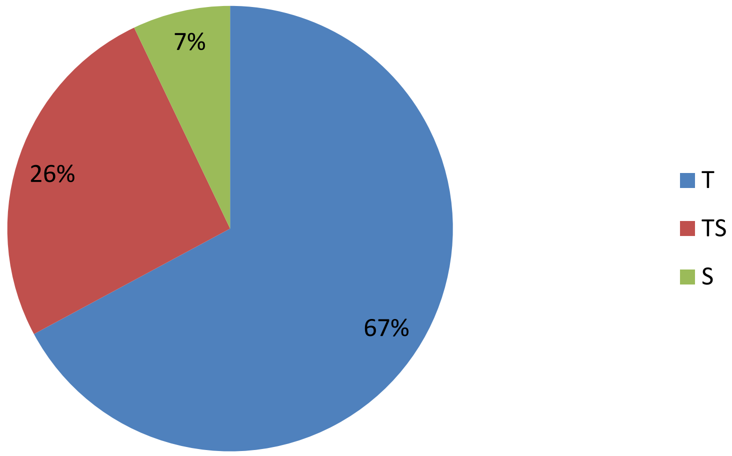
7.2. Realisers (Hofmann)

A further dimension that will be considered in the course of this quantitative study is the distribution of realisers, that is, whether an utterance was produced by either the teacher (T), a student (S), or a combination of both (TS). The analysis of realiser distribution will be sectioned according to different contexts: in the first place, realisers will be considered in comparison to each other and in isolation to other factors, secondly, the distribution of realisers will be analysed according to the eight lessons A1 – B4, and thirdly, data will be arranged to provide information about realisers among the two teachers, T1 and T2. In yet another section realisers and CDF distribution in combination will be topicalised.

Realisers in isolation

The distribution of realisers as total percentages in comparison to one another is given in figure 11.

Figure 11. Distribution of realisers T, TS, S as percentages



It is not striking that by far the least realisations were made by students alone, claiming a total share of less than a tenth of the coded CDF passages. Combined teacher-student-realisations take up middle-ground and amount to about a fourth of all coded passages. This share is fairly small if compared to Kröss' data, which indicate a teacher-student patterning with far more than 50% of total passages. In this sense, interestingly, the positions of T- and TS-realisations seem to be reversed in our study and hers. Around two-thirds of our coded data were realised by the teacher alone. The percentage shares of realisers gives of course very limited information about the actual speaking-time, not least because coded passages vary greatly in length, Teacher-realisations often stretching to many minutes and students' answers seldom exceeding a single sentence or even less. What is more, TS-coded passages are not constructed by teachers and students in equal measure, teachers in many cases providing most of the input and students only speaking, and briefly, when requested to do so.

Realisers across lessons

An analysis of realisers across lessons should give an insight into the generalisability of realiser distribution. If said distribution differs little across individual lessons, a conclusive statement that content does not affect realisation types greatly might be formed.

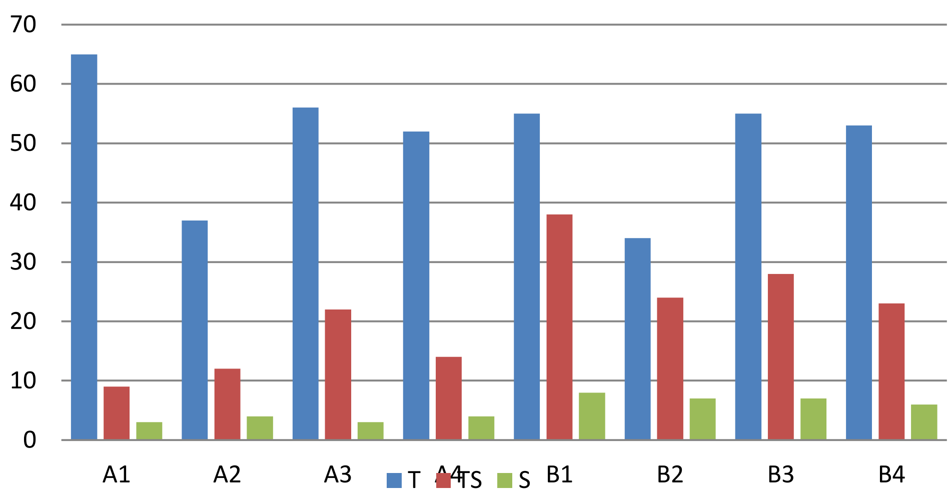
Table 17. Distribution of realisers T, TS, S across lessons A1 – B4

	A1	A2	A3	A4	B1	B2	B3	B4	total
T	65	37	56	52	55	34	55	53	**407**
TS	9	12	22	14	38	24	28	23	**170**
S	3	4	3	4	8	7	7	6	**42**
total	**77**	**53**	**81**	**70**	**101**	**65**	**90**	**82**	**619**

Starting again with the least frequent realisation type, S, table 17 shows that student realisations occurred between 3 and at most 8 times per lesson. Realisations made by both, teacher and students, vary from nine to 38, with an average of 21 occurrences per lesson. More of these TS-realisations by far were detected in lessons B1 – B4, that is, in T2's lessons. T-realisations, meanwhile, vary from 34 occurrences in lesson B2 up to 64 in lesson A1. The average amount of T-realisations per lesson is at 51.

Figure 12 again gives an overview of realisers in individual lessons.

Figure 12. Distribution of realisers T, TS, S across lessons A1 – B4



What becomes evident from this graph is the uneven distribution of TS-realisations, the majority being located in lessons B1 – B4. The lesson with the least amount of TS-realisation still outreaches the lesson with most instances in the first quartet. S-realisations are distributed similarly, being around twice as frequent in lessons B1 – B4. The most extreme numerical discrepancy between realisers can be found in lessons A1, A2 and A4, where utterances both made by students and teachers together and students alone make up no more than a dwindling share of total realisations if compared to T-realised CDFs. Only lesson A3 just scratches the average of 21 TS performances per lesson. The distribution of realisers is slightly more even across lessons B1 – B4, TS-realisations all being above the average of 21, while CDF utterances performed by the teacher are slightly above the mean number of 51, except in lesson B1.

Realisers across teachers

The distribution of realisers across teachers aims at identifying possible teacher-dependent patterns, which can have an influence on the quantitative occurrences of each of the three individual realiser types.

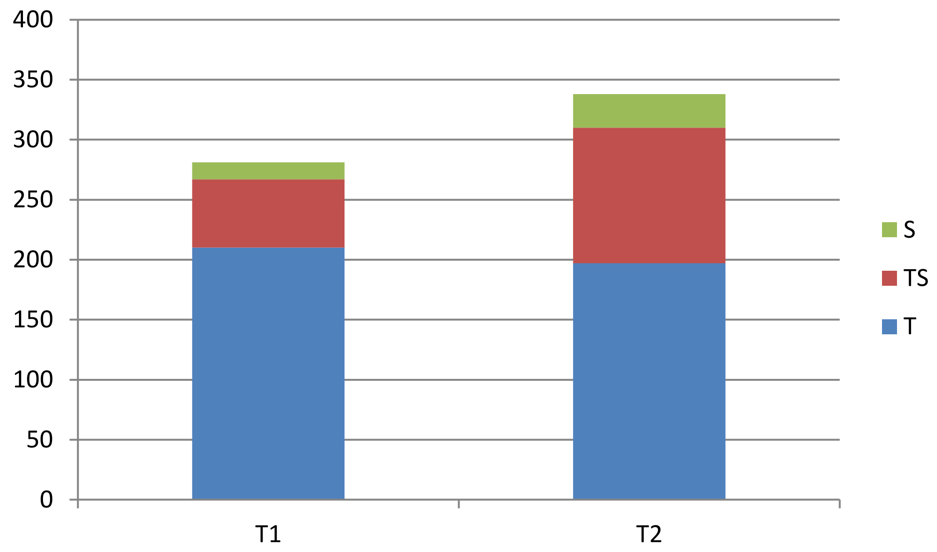
Table 18. Distribution of realisers T, TS, S across teachers T1, T2

	T1	**T2**	**total**
T	210	197	**407**
TS	57	113	**170**
S	14	28	**42**
total	**281**	**338**	**619**

What first catches one's eye with regard to table 18 is the considerably unequal partition of total realisations among both teachers, the lessons of T1 accounting for 281 realisations, and the lessons of T2 for 338, resulting in a difference of nearly ten percent of the total. It is clear, therefore, that there is need for the comparison of many more teachers to deduce general conclusions about average CDF numbers. Taking a closer look at the distribution of individual realisers it becomes evident that the deviations are very extensive in two of the three categories: while the number of T-realisations differ very little across the two teacher, TS- and S-realisations are twice as high in T2's lessons.

This can also be deduced from the graphic representation of the data in figure 13.

Figure 13. Distribution of realisers T, TS, S across teachers T1, T2



TS-realisations and verbalisations made by students alone are twice as frequent under T2's teaching, while T1's lessons constitute more cases of realisations made by just the teacher. This brings up the question as to whether at this point a first guess about teaching styles could already be ventured, such as a raised number of passages involving Triadic Dialogue in T2's lessons, due to the abundance of TS-realisations in contrast to T1's lessons, or a higher number of more complex CDF forms in T1's lessons, due to more utterances realised by T. It is hoped that these questions will, at least partly, be resolved during the qualitative analysis of the recorded lessons. Discrepancies in the realiser-distributions between the two lessons quartettes A1 – A4 and B1 – B4 are considerably larger than across individual lessons of the same teacher, which prompts the suggestion that the content of individual lessons of the same teacher plays not as significant a role as the teacher and his or her teaching style.

7.3. CDFs across realisers (Hofmann)

The next step is to give a dual-focused analysis of realisers and cognitive discourse functions in combination, with the aim to identify possible concordances between CDF-types and types of realisers. Again, three figures will be used to present the relevant data: the first one (table 19) gives an overview of the numerical values of T-, TS-, and S-realisations of each of the seven CDF categories, the second one (figure 14) arranges data so as to compare the distribution of CDFs in percentage shares within each of the three realisers, and finally, the third figure (figure 15) is a bar chart emphasising the opposite arrangement to the previous figure, displaying data in a way to present realiser-distribution within each of the CDF categories.

From the overview of total realisations in table 19 it becomes clear that occurrences of CDFs vary largely across realisers.

Table 19. Distribution of CDFs across realisers T, TS, S

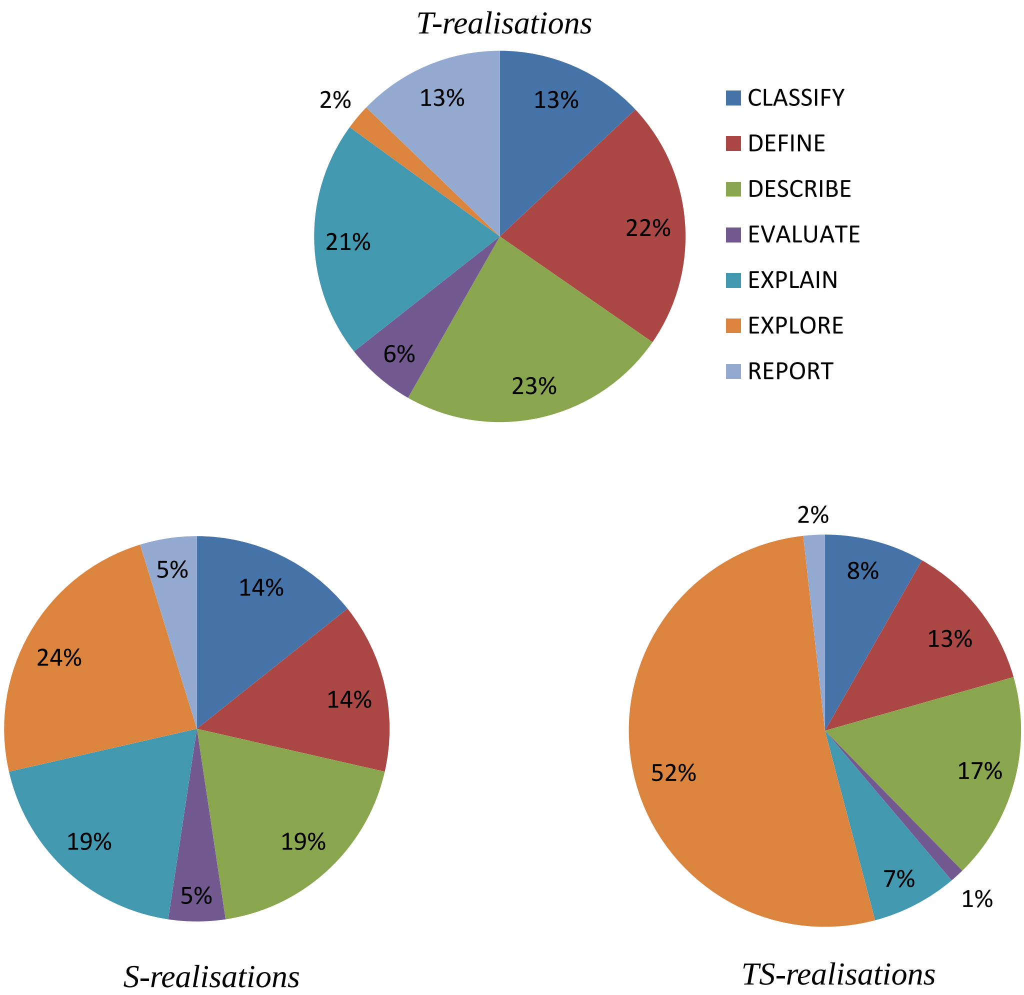
	T	**TS**	**S**	**total**
CLASSIFY	53	14	6	**73**
DEFINE	88	21	6	**115**
DESCRIBE	96	29	8	**133**
EVALUATE	25	2	2	**29**
EXPLAIN	84	12	8	**104**
EXPLORE	9	89	10	**108**
REPORT	52	3	2	**57**
total	**407**	**170**	**42**	**619**

T-realisations dominate in each CDF category apart from EXPLORE, which is realised by far the most often by teachers and students combined. If EXPLORE is not counted, T-realisations range from a minimum number of 52 REPORT-occurrences to a maximum of 96 DESCRIBE-instances. As such, the minimum number of occurrences realised by the teacher still outreaches by far the maximum number of instances of **TS-realisations**, which obtain a maximum value of 29 instances of DESCRIBE, again leaving aside EXPLORE. The distribution of realisers of EXPLORE appears to be quite reversed, T-realisations being as infrequent as are normally S-realisations, and TS-realisations dominating over the other two realiser types with no less than 89 passages. A strikingly low number of realisations from TS is recorded among EVALUATE with only 2 occurrences throughout all eight lessons. **S-realisations** all remain under, or at the most, 10 occurrences of each CDF, the most abundant instances observable in the EXPLORE category. Instances of four of the seven CDF types are numerically fairly similar among S-realisations, two of them being realised 6 times and two of them 8 times.

Considering the data from the perspective of individual CDF types, DESCRIBE contains the highest number of utterances with a total of 133, realisations made by the teacher being thrice as common as TS-realisations. EVALUATE appears to be performed quasi exclusively by the teacher, TS- and S- realisations altogether holding no more than 4 instances. An even more extreme case is REPORT, where the latter two realiser types put together make up no more than 9%. EVALUATE is by far the least frequently observed CDF type in all three realiser categories.

Figure 14 visualises the distribution of CDFs as percentage shares within the three realiser types. It is essential to bear in mind that the amount of total realisations by each realiser differ largely, a fact that cannot be deduced from the figure, but makes the direct comparison of CDF distribution according to realiser problematic in this figure.

Figure 14. Distribution of CDFs across realisers T, TS, S



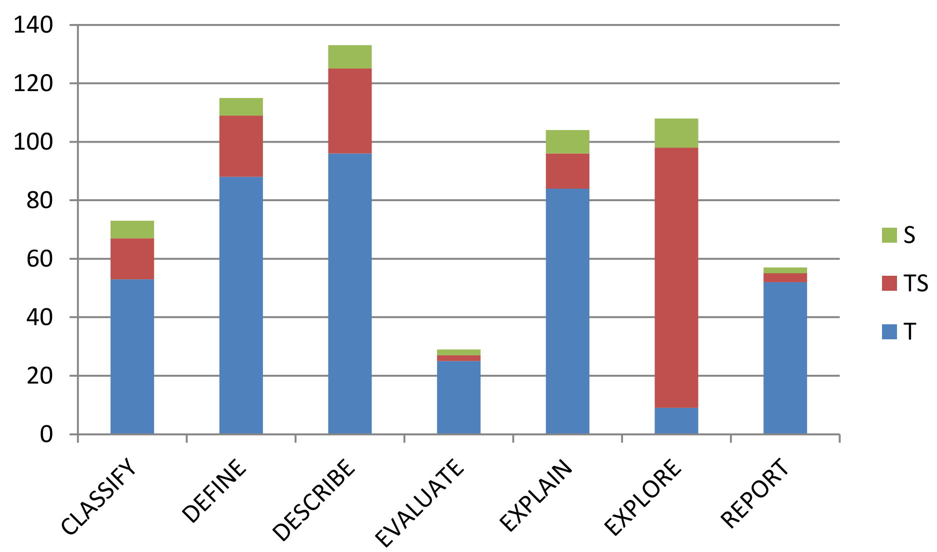
T-realisations make up by far the most CDF occurrences, a fact that renders deductions about CDFs within this realiser-type more precise in comparison to S- and TS-realisations, which account for much less instances in total. What becomes evident when looking at T-realisations is that the three most often represented CDFs (DF, DS, EA) claim relatively similar shares, ranging from 21% EXPLAIN to 23% DESCRIBE. CLASSIFY and REPORT make up little more than a tenth each, and EXPLORE and EVALUATE are located at the rear end with only 2% and 6% of the total amount of T-realised passages, respectively.

TS-realisations demonstrate a very interesting distribution of CDF types. Over half of the total amount of realisations are instances of EXPLORE. The second place is occupied by DESCRIBE which holds 17%; the gap between most frequent and second-most frequent CDF type within TS-realisations is thus fundamentally large. DEFINE is closely behind DESCRIBE with a share of 13%, and the least frequently uttered CDF-types (CL, EV, EA, RP) each make up less than 10%, REPORT and EVALUATE realised least often, constituting no more than 3% together.

S-realised occurrences exhibit a rather equal share between all seven CDF-types, the one disrupting the pattern slightly being REPORT and EVALUATE, with each no more than 5% of S-realised utterances. All other CDF-types are represented in students' talk with a claim between 14% and 24%. DESCRIBE is the peak performer, followed by two CDFs with 19% each, DESCRIBE and EXPLAIN, and two with 14% each, CLASSIFY and DEFINE. In relation to the curiously homogenous distribution of some percentage shares one needs to take into consideration the low amount of total S-realised utterances which render such a pattern easily possible: all seven CDFs are realised no more than 10 times each by students, so the chance of their being performed exactly the same number of times is necessarily higher than in the T-realisations category, where total amounts are tenfold greater.

Figure 15 is a graphic representation of the realiser distribution throughout each of the seven CDF categories.

Figure 15. Distribution of realisers T, TS, S across CDFs



The most striking feature is the abundance of T-realisations across all CDF types, except in EXPLORE, which is comprised mainly of a combination of teacher's and students' utterances. As such, all CDFs show a very similar realiser distribution, T-realisations being on average three-times more frequent than TS-realisations, if not more, as is the case in EVALUATE, REPORT and EXPLAIN. S-realised instances of CDFs are again considerably fewer than TS-realisations, except in REPORT and EVALUATE, where S- and TS-realisations are head-to-head with each other. The CDF category of EXPLORE does not in the least resemble the six remaining types, which all share the just outlined common distribution pattern. It is realised thrice as often by TS than S- and T-realisations put together and, in terms of most frequently observed CDF-and-realiser combination, reaches second place with 89 occurrences, after T-realised DESCRIBE-instances, which are 96 in total.

A comparison to Kröss' data (2014: 55-59) yields a range of interesting discrepancies: in five of the seven CDF categories which are considered in the present study her main type of performer was a combination of teacher and student(s), CLASSIFY and EVALUATE being the only exception, the latter having been verbalised, an even more drastically small number than in our data, only once in the first place. In her data, thus, TS-realisations are by far the most frequent mode of CDF realisation, while our data clearly point to T-dominated occurrences. This circumstance is most likely due to the fact that Kröss' focus lies primarily on longer realisations of CDF passages, while our study analyses the individual parts of what may make up a larger CDF-episode. It is only reasonable that such longer episodes are more likely to involve a combined attempt of teacher and student(s), while the individual, often rather short, CDFs, of which these episodes are comprised, may, to a great extent, be verbalised by the teacher.

Also the distribution of CDF types across the three realisers differs considerably between Kröss' and our data: while the most frequent CDF type is different among each realiser in our data, DESCRIBE was found to constitute the highest numbers of occurrences among all three realiser-types in her corpus. What is more, its percentage shares are all fairly similar, ranging from 28% to 33%, whereas in our corpus data the most frequently observed CDF type among each realiser point to a paramount divergence, with instances of EXPLORE realised by TS being more than twice as abundant as the most frequently used CDF type of the two other realisers (DESCRIBE-T and EXPLORE-S) put together.

Another circumstance worth mentioning is the fact that in our data all seven CDF-types were verbalised by all three realisers, while Kröss' records display a complete absence of some CDF types among TS- and T-realisations: EXPLAIN, EXPLORE and EVALUATE have not been performed by students even once, and the last one is also missing in the total amount of TS-realised utterances. The reason for this absence of some CDF types among some realisers in her corpus may again be the different approaches of the two studies: individual, small CDF-moves, if expressed in Kröss' terms, are more probable to occur also in students' talk, while entire CDF-episodes would be more demanding to be realised by students alone, especially in the case of complex CDF types like EXPLAIN and EVALUATE.

7.4. Episodes (Hofmann & Hopf)

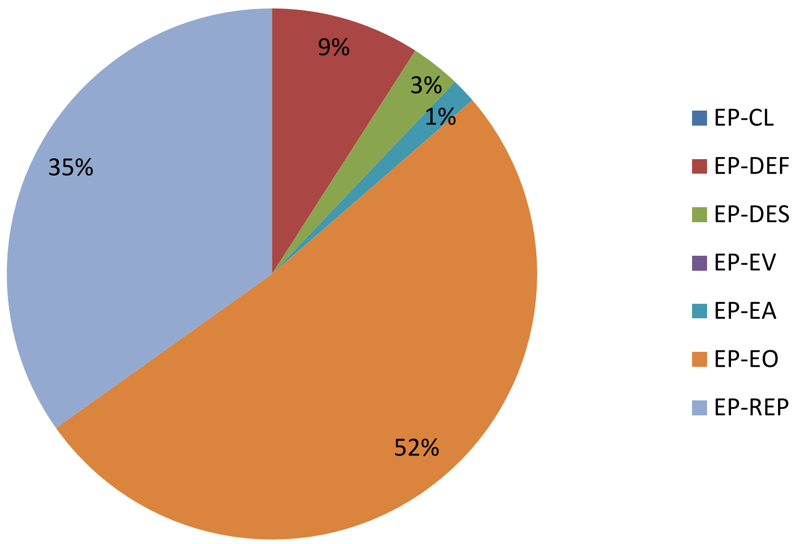
The analysis of the observed lessons revealed that several CDFs are of a rather extended character and thus exceed the length of only one or two sentences. Moreover, these special CDFs often include instances of various other CDF types, causing the formation of a phenomenon we decided to call a **CDF episode**. Kröss (2014) reported on similar occurrences in her study concerned with CLIL Physics lesson but instead of perceiving them as episodes, she understood them to be the actual CDFs, classifying the included shorter CDFs as "moves" (Kröss 2014: 36). Based on the outcomes of our analysis, we have to disagree with this classification, since a lot of our material would have to be ignored if only longer episodes consisting of different moves were considered to be CDFs. Since CDFs appeared in groups as well as individually we established this concept of CDF episodes, which is going to undergo a quantitative analysis in the course of this chapter.

Episodes in isolation

Apart from functions brought about by included CDFs, each episode proved to perform an overall function, which determines their title for the purpose of this study. Based on that, for instance, an episode with the overall function of EXPLORE, although including CLASSIFY and EXPLAIN, is nevertheless called an episode of EXPLORE (EP-EO).

Figure 16 presents the distribution of episodes according to these different types.

Figure 16. Overall distribution of episode types.

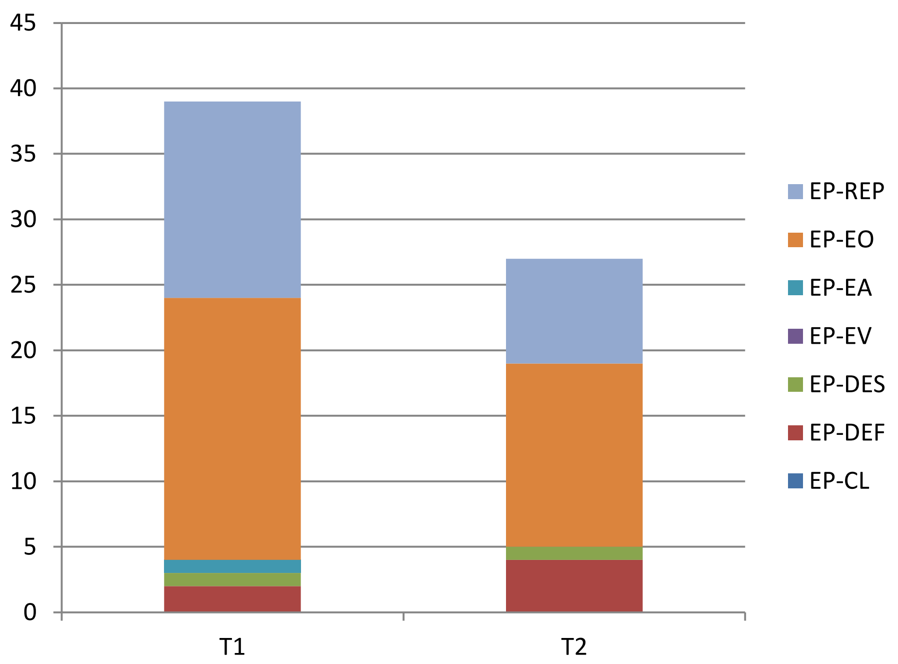


The graph shows that episodes of EXPLORE and REPORT add up to 87% of all observed episodes, leaving episodes of DEFINE, DESCRIBE and EVALUATE with a small share of only 13%. A particularly noteworthy aspect is that although EXPLORE and REPORT by far constitute most episodes, both of them are not among the most frequently uttered CDFs in general terms (see Figure 8). While more than half of all episodes (52%) take the function of EXPLORE only 17% of all CDFs in general can be classified as an exploration. Even more remarkably, REPORT was found to occur least frequently in a general context, accounting for only 9% of all utterances, but nevertheless constitutes the second biggest group of CDF episodes with a share of 35%. When comparing actual examples of all CDF types, one will come to the conclusion that especially EXPLORE and REPORT often occur in longer sequences. This extended length of certain utterances appears to qualify them as potential CDF episode. Additional support for this hypothesis is provided by the limited amount of appearances of episodes constituted by shorter CDFs like DEFINE, DESCRIBE and EXPLAIN. Furthermore, CDFs that never exceeded the length of one or two sentences, like CLASSIFY and EVALUATE, were not found to constitute episode at all.

An interesting correlation is observable if Figure 16 is compared to the pie chart illustrating TS-realisations of CDFs in Figure 14. While episodes of EXPLORE account for 52% of all episodes, the CDF EXPLORE constitutes also 52% of all TS-realised CDFs. This conformity might root in the fact that most CDF episodes are co-constructed by teacher and students, which explains the similarities between the pie charts presenting the distribution of episodes and those illustrating TS-realisation.

Like figure 17 illustrates, trends observed with the overall distribution of episode types also hold true if CDF episodes uttered in lessons of different teachers are compared.

Figure 17. Distribution of CDF episodes across teachers T1, T2



As can be inferred from the chart, lessons taught by Teacher 1 as well as Teacher 2 mostly feature episodes of EXPLORE followed by a frequent appearance REPORT episodes. Thus, there is no noticeable difference between the overall distribution of episodes and their distribution across the different teachers.

The only difference observable between the lesson-quartets of Teacher 1 and Teacher 2 is the varying amount of episodes in general. While Teacher 1's lessons show an implementation of 39 individual episodes, only 27 episodes are encountered in Teacher 2's lessons. This might be caused by different teaching styles, but also the language level of the taught classes might render differences here. Since episodes of CDFs are often rather complexly structured sequences, they might show a higher frequency of occurrences when students of a more elaborate language level are taught. In the case of this study Teacher 1's students, being 2 years ahead, definitely show a higher language level, which might qualify them to cope with a more frequent use of complex structures.

CDFs within episodes

In a subsequent step the average number of included CDF occurrences within the different episode types will be topicalised.

Table 20. Average number of CDFs within episodes

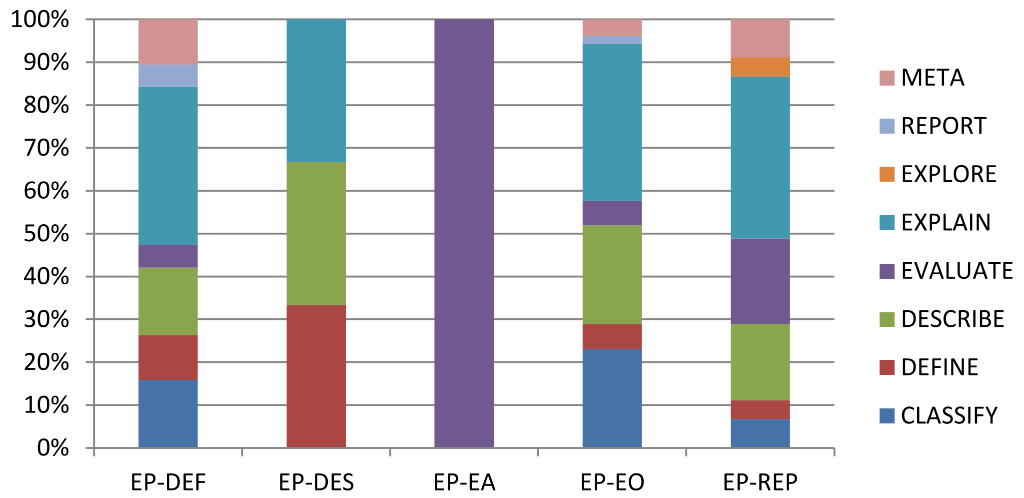
Episodes	Average number of included CDFs
EP-CL	0
EP-DEF	3
EP-DES	1,5
EP-EV	0
EP-EA	1
EP-EO	1,5
EP-REP	2

The average ranges from 0 included CDFs in CLASSIFY and EVALUATE episodes to a maximum mean of 3 CDF-inclusions per passage in the DEFINE type. The second-largest number of CDF inclusions is found in REPORT episodes with an average of 2, and DESCRIBE and EXPLORE episodes contain on an average level between 1 and 2 CDFs. Only one single EXPLAIN episode has been encountered in the corpus and it contains only one CDF. Due to its considerable length and complexity it counts as episode nonetheless.

As to factors contributing to the range of mean number of included cognitive discourse functions in different episode types, it is suggestive that, at least in some cases, a reason can be detected in their internal nature: DEFINE episodes, for instance, occurred only in combination with one particular type of definition, namely the complex, explicative type. A fact which has already been pointed out in the theoretical introduction is the relatively compact nature of, as the name suggests, complex explicative definitions. A logical result of this phenomenon is the comparably high number of included CDFs within explicative definitions. Similarly, REPORT episodes are usually fairly extensive in length and thus may to a greater extent than others involve other CDF types, such as explanations or descriptions.

In a final step the internal structure of the individual episode types in terms of included CDF types and their percentage shares will be evaluated. The figure below contains only five pillars, as the two CDF types constituting no episodes at all have been omitted for reasons of comprehensibility.

Figure 18. Percentage shares of CDF type within episodes



There are various interesting aspect to be read from this figure: first of all, the diversity of included CDF types clearly differs across episode types, the most colourful being also the ones containing the most number of different types. All three of the following types, DEFINE-, EXPLORE- and REPORT-episodes displayed a total number of 7 distinct CDF types, the first two exactly the same range of different CDFs, whereas REPORT-episodes lack, quite naturally, their own CDF type, but contain explorations instead. DESCRIBE-episodes appear to contain 3 other CDF types, all to a fairly equal numeric representation. The one EXPLAIN-episode contained only a single other CDF type, which was an evaluation.

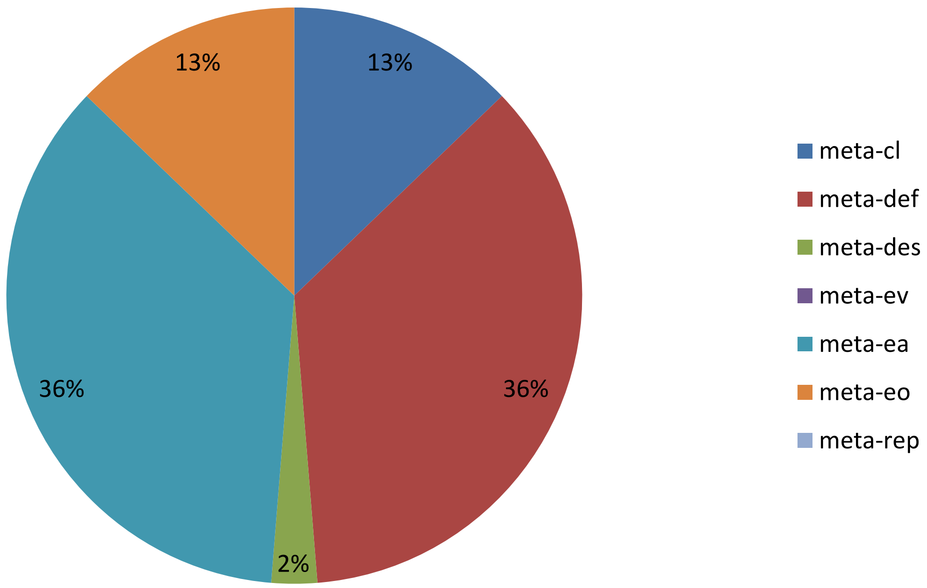
A further insightful circumstance is that DEFINE- and DESCRIBE-episodes both include instances of their own CDF type. This phenomenon arises from the fact that their CDF categories are comprised of a variety of sub-types, which may in some cases come to co-exist within the same passage. In this sense, a DEFINE-episode is not unlikely to contain other instances of DEFINE, which are shorter, such as a simple definition within a complex one, or a DEFINE-translation within an explication. Comparably, an episode designed to describe a process may be prone to involve shorter instances where a physical description or a function description is placed within the greater DESCRIBE-episode. EXPLORE and REPORT, on the other hand, are in their realisation usually relatively extensive and do not have shorter forms; therefore they are less prone to include their own type within their episodes.

Discounting the single EXPLAIN-episode, a general statement as to the likeliness of the inclusion of certain CDF types can be made: explanations and descriptions seem to be rather commonly included CDF types, featuring frequently in all episode types. Also instances of definitions are represented regularly, though in smaller a quantity, apart from DESCRIBE-episodes, in which they appear to hold an important position, along with explanations and descriptions. Classifications, evaluations and even instances of meta-language feature to a considerable extent in three of the presently considered four episode types. Reports and explorations, as has been previously highlighted, are unlikely to be included in episodes due to their length. More often they constitute episodes themselves.

7.5. Meta-talk (Hopf)

While similar studies concerned with the implementation of discourse functions in the CLIL classroom reported a rather restricted use of meta-talk (e.g. Dalton-Puffer 2007 and Lackner 2012), the data of this study offers a number of instances worth mentioning. On this account, a whole chapter is dedicated to the quantitative analysis of meta-talk present in the observed biology CLIL lessons, in which the numbers of general occurrences, as well as their distribution across lessons and teachers will be discussed. A total number of 39 occurrences of meta-talk found in the analysed set of data distributed over eight lessons each 50 minutes long result in an average of 1 instance every 10 minutes. As already mentioned in the section 'Code overview', the data for the analysis of meta-talk was split into several sub-categories. In accordance with the CDFs that form the content of the different instances of meta-talk, they are arranged into the following 7 suggested categories: *meta-classify, meta-define, meta-describe, meta-evaluate, meta-explain, meta-explore* and *meta-report*. Figure 19 presents the general distribution of meta-talk according to these categories.

Figure 19. Total counts of *meta-talk* as percentages



As can be inferred from the pie chart, not all suggested categories of meta-talk are present in the analysed data. No meta-talk about EVALUATE and REPORT was uttered during the eight observed lessons. The most frequently realised types of meta-talk are *meta-define* and *meta-explain*, both accounting for 36% (14 instances) of the total count. Meta-describe on the other hand, is by far the least frequently uttered type of meta-talk while only accounting for 2% (1 instance) of total counts. This leaves the rest of utterances equally distributed to the categories meta-classify and meta explore, each taking up 13% (5 instances).

Meta-talk across lessons

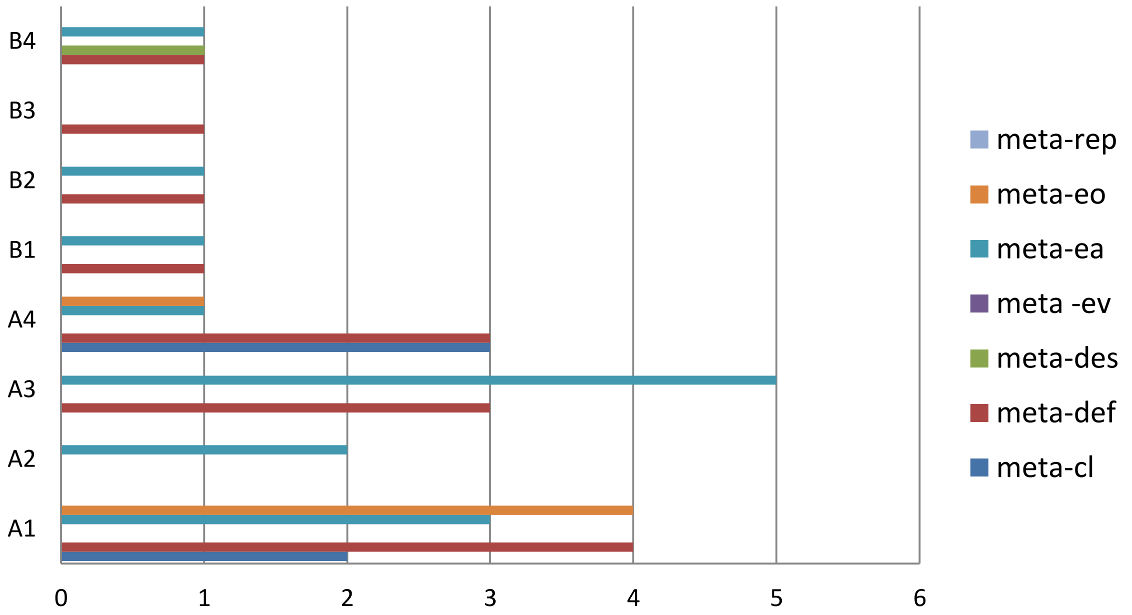
While figure 19 presents a general distribution of different types of meta-talk within the framework of this study, table 21 and figure 20 illustrate the situation apparent in individual lessons.

Table 21. Distribution of different *meta-talk* across lessons A1 – B4

	A1	A2	A3	A4	B1	B2	B3	B4	**total**
meta-cl	2	-	-	3	-	-	-	-	**5**
meta-def	4	-	3	3	1	1	1	1	**14**
meta-des	-	-	-	-	-	-	-	1	**1**
meta -ev	-	-	-	-	-	-	-	-	**-**
meta-ea	3	2	5	1	1	1	-	1	**14**
meta-eo	4	-	-	1	-	-	-	-	**5**
meta-rep	-	-	-	-	-	-	-	-	**-**
total	**13**	**2**	**8**	**8**	**2**	**2**	**1**	**3**	**39**

Highly varying numbers of meta-talk instances are observable when the different individual lessons are taken into account. There are lessons which feature a high number of meta-talk implementations, like lesson A1 with 13 instances, whereas this language feature is rather under-represented in other lessons, like lesson B3 with only one single instance. Furthermore, not only the number of realised meta-talk varies if different lessons are compared, but as figure 20 presents, also the types of meta-talk vary in terms of frequency of realisation across lessons.

Figure 20. Distribution of *meta-talk* across lessons A1 – B4

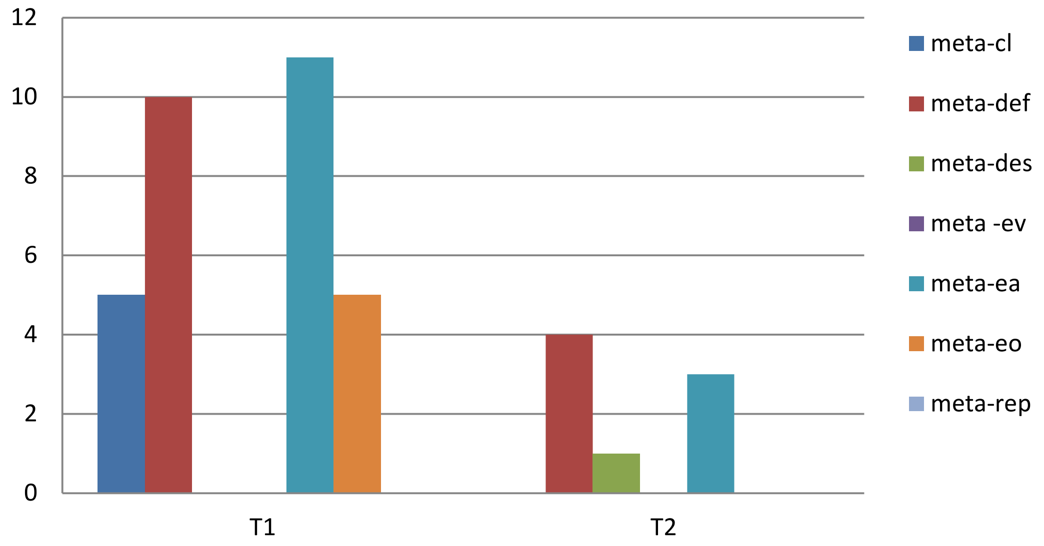


When looking at figure 20, one immediately realises that the two meta-talk types *meta-explain* and *meta-define*, which classified as most frequently uttered types in the general context, frequently occur in most of the individual lessons as well. Interestingly, meta-explain is not only one of the two most often used meta-talk types, but it is further the only type which is implemented five times in only one lesson (A4). Thus, comparing figure 19 and figure 20, an apparent correlation of the number of general utterances and the amount of lessons in which a meta-talk type occurs becomes recognisable. While the least often uttered type *meta-describe* is only present in one lesson (B4), *meta-explain* and *meta-define,* which are the top two meta-talk types concerning their frequency of occurrence, are both present in 7 out of 8 lessons. This distribution shows, that the high number of utterances attributed to *meta-explain* and *meta-define* is not primarily grounded on their enhanced use in one or two lessons but rather on their frequent participation in various lessons. Although the data is too limited to make an attempt of any kind of generalisation, it might be argued that these two meta-talk types are, compared to all the others, a rather consistent part of CLIL lessons. However, numbers of these two meta-talk types might further change if certain qualitative aspects were taken into consideration for a quantitative analysis, since, as mentioned in the course of the theoretical discussion of EXPLAIN (5.5.), especially *meta-explain* is sometimes found to be misapplied for talking about definitions.

Although apparently the importance of certain meta-talk types is still observable when the distribution across lessons is taken into consideration, in some cases those types, which are not very prominent in terms of general counts, nonetheless seem to play an important part in special lessons. In lesson A1 for instance *meta-explore,* which only accounted for 13% of meta-talk in the overall distribution, is one of the two most frequently uttered meta-talk types. Topic-wise this and also the following lessons were concerned with 'Mendelian rules of inheritance' which triggered a lot of EXPLORE sequences. When looking back at figure 10 it becomes apparent that lessons A1-A4 taught by Teacher 1 feature EXPLORE as the most frequently used CDF. Thus, the large amount of *meta-explore* utterances might be attributed to the apparent importance of the CDF EXPLORE for the topics taught in lesson A1-A4.

In sum, although a strong correlation between general occurrences of meta-talk types and their distribution across lessons is observable, some topics or methods of special lessons (e.g. A1) seem to trigger an increased use of generally rather under-represented meta-talk types. A look at figure 21 will clarify if the individual teaching style of different teachers might have an influence on meta-talk use as well.

Figure 21. Distribution of *meta-talk* across teachers T1, T2



Since every instance of meta-talk found in the data was uttered by a teacher, a discussion of realisers is of no use here. The first striking difference when comparing Teacher 1 and Teacher 2 is the amount of meta-talk uttered by each teacher. While Teacher 1 implements a total of 31 instances of meta-talk, only 8 meta-talk related utterances can be counted in Teacher 2's lessons. The most frequently used meta-talk types in both lessons are *meta-define* and *meta-explain*, which again stresses the previously observed prominence of these two types. The figure further shows, that not every meta-talk type was implemented by each teacher. Teacher 1 uses instances of *meta-classify* (5 instances) and *meta-explore* (5 instances) alongside the other two frequently used types while Teacher 2 only additionally utters a *meta-describe* (1 instance). Compared to the results concerning *meta-define* and *meta-explain*, uttered by each teacher, these three other types of meta-talk implemented add up to only a small part of the overall count of meta-talk instances in each teacher's lessons.

Owing to the small amount of previous findings on CDF-specific meta-talk in classroom discourse, unfortunately there are no comparable results that could provide further evidence for any assumptions made in this chapter. Former studies (e.g. Dalton-Puffer 2007, Lackner 2012) on discourse functions in CLIL education always reported a lack of such instances. Nevertheless, this study brought forth several meta-talk related utterances and some trends become apparent which certainly need to be investigated and tested further. Keeping this in mind, the only thing which might be suggested is that *meta-define* and *meta-explain* play an important role regarding CDF-related meta-talk, since they showed a high frequency of occurrence, independent of different lessons or teachers. However, the very different amount of meta-talk incorporated into classroom discourse by each teacher seems to point towards the range of implemented meta-talk being highly dependent on the individual teacher.

7.6. Discussion of predictions (Hofmann)

Based on our quantitative results, the predicted frequencies of certain CDF types according to the type of topic can now be evaluated:

Table 22. Predicted CDF frequencies and results

CDF type	Predicted frequency	Result
	Teacher 1: Mendel genetics	
CLASSIFY	high	sligtly higher
DEFINE	high	slightly lower
DESCRIBE	low	low
EXPLAIN	high	High
EXPLORE	high	Low
	Teacher 2: Transport across membranes	
CLASSIFY	low	slightly lower
DEFINE	high	slightly higher
DESCRIBE	high	High
EXPLAIN	high	Same
EXPLORE	low	High

CLASSIFY was estimated to occur rather frequently in T1's lessons and to a lesser extent in T2's lessons. A quantitative analysis revealed that numbers were slightly higher in the lessons about Mendel genetics, but not as significantly as predicted. DEFINE was estimated to be of great abundance in both lessons, which could indeed be verified; in T1's lessons numbers were a little higher than in the lessons about transport across membranes. The only CDF type where predictions met precisely the two sets of quantitative data was DESCRIBE, which was found in high numbers in T2's lessons and to a comparably insignificant share in T1's lessons. EXPLAIN was realised in similar amounts across both lesson quartettes. EXPLORE, finally, was the only CDF type which revealed results quite opposing to our estimations: Mendel genetics being largely about inferences and predictions, we predicted these lessons to contain a large variety of explorations, while the topic on transports was meant to yield a lower number, but the quantitative distribution clearly points to the reverse.

It is risky to make generalisations about the predictability of CDF distribution across lesson topics at this stage, predictions having been both verified and refuted. What does seem to be a reasonable conclusion is that DESCRIBE may in fact really depend, to a certain extent, on the nature of the lesson topic, while EXPLORE is largely dependent on the teachers preferred teaching methods and cannot be predicted according to the topic that is being discussed.

8. Qualitative analysis

This second part of CDF analysis discusses all seven types of CDFs on the basis of a variety of qualitative criteria, such as

- sub-types,
- contexts,
- functions and form
- main and minor realisers,

Owing to the different natures of the seven CDFs, the priorities set in each analysis may vary considerably.

8. 1. **CLASSIFY** (Hopf)

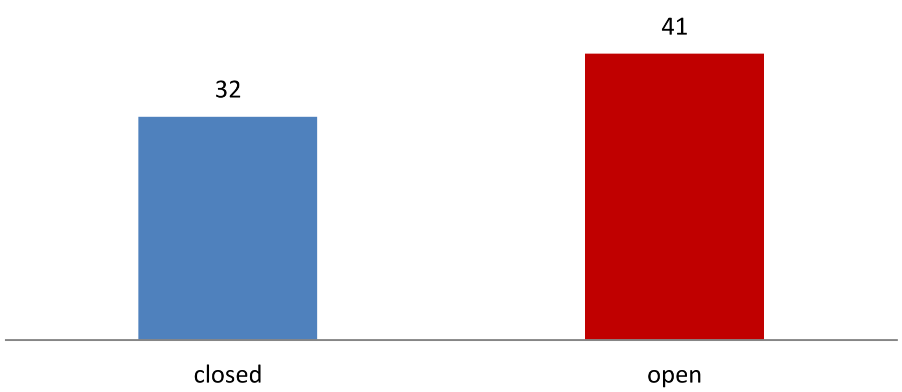
8.1.1. Types of classifications

All types of classifications suggested by the reviewed literature were found in the investigated set of data and hence, are going to be object of discussion in the following passages.

Closed and open classifications

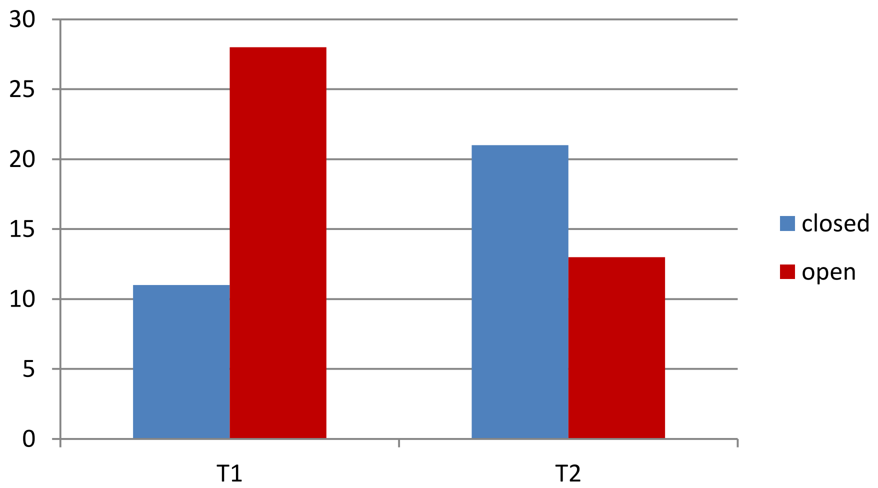
According to Trimble (1985: 87), a general distinction between *open* and *closed classifications* can be made, depending on wether the list of class members is finite or endless. This feature of classifications is influenced by the nature of a class only, which is why some classes like 'types of leaf pigments' naturally have a finite number of members while classes like 'inheritable diseases' do not have at least a countable number of members. Accordingly, if a class is open or closed is predefined and cannot be influenced by the realiser. Owing to these considerations, when looking at a certain set of data, an even distribution of open and closed classes might be expected. The actual numbers of open and closed classifications found in the current data are presented by the following figure.

Figure 22. Numbers of *closed* and *open classifications* in comparison



As can be inferred from figure 22, 41 out of 73 overall instances proved to be open classifications and in contrast to that, only 32 instances of closed classifications were observed. The cause of this uneven distribution might be deduced from results presented by figure 23, which illustrates the distribution of both types of CLASSIFY across the two teachers.

Figure 23. Distribution of *open* and *closed classifications* across teachers T1, T2



The relatively high number of open classifications appears to root in the high amount of this type of CLASSIFY occurring in T1's lesson. Another recognisable factor illustrated by figure 23 is that while T1's lessons feature more than twice as many open than closed classifications, a higher frequency of closed classification is observable in T2's lessons. These differing results indicate that although, as proposed, realisers themselves have no influence on this feature of CLASSIFY, there has to be some other influential factor. In this respect, note has to be taken of the different topics approached by the teachers and accordingly, the different types of provided information, which serve as classification material.

Teacher 2 is concerned with the transport of molecules across membranes and the plasma membrane in general, which causes different physical processes and molecules taking part in these processes to be the most frequently classified information during the four lessons. As illustrated by examples 33a-c, physical processes and chemical substances seem to prompt closed classifications, as both constitute classes with a finite number of members.

Example 33.

a. T: Uhm then we will come to a special kind of diffusion and that's called osmosis.
b. T: So substances that can easily cross the membranes are small molecules, gases, for example.
c. T: What do we call this?
   Sm: Cell respiration.
   T: Yeah we call this respiration or breathing, yes.
   Sm: Aerobic cell respiration.

Teacher 1's lessons, on the other hand, revolved around genetics, comprising the discussion of several genetic conditions and paths of inheritance. Since such classes include numerous, almost uncountable members and are certainly still extendable, related classifications, like those presented by examples 34a-d, are most often open.

Example 34.

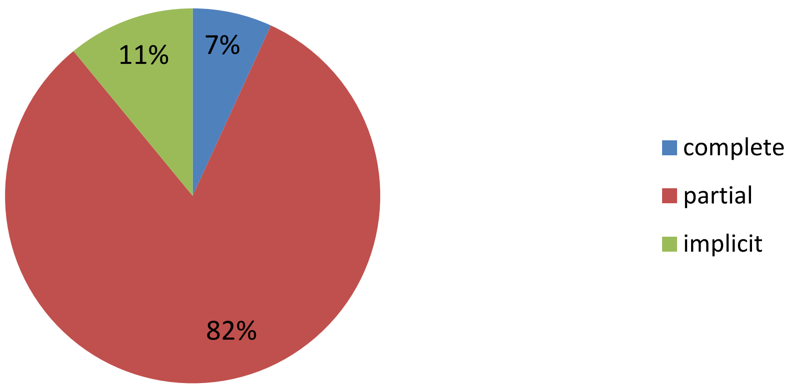
c. T: Huntington's Disease is a dominant condition.
d. T: another sex-linked recessive would be colour-blindness.
e. T: So; it is an inherited.
f. T: Now; blood groups are an example; they're an example of so-called multiple alleles and co-dominance.

Of course, as figure 23 indicates, lessons taught by each teacher provided examples of both classification types, but the content a teaching sequence is concerned with seems to influence the frequency of open and closed classifications to a certain extent. Information can only be either classified into closed or open classes and some topics apparently show tendencies to trigger classifications of either one of these information types.

Complete, partial and implicit classifications

The three categories *complete, partial* and *implicit classifications* are based on the amount of information given by a classification and the way in which it is presented. While complete classifications inform about class name, members and basis of classification, the basis is left out in partial classifications. Implicit classifications also present all relevant information, though not in direct classifying terms (Trimble 1985: 93). All three of these types of CLASSIFY occurred in the investigated set of data with strongly varying frequency. Figure 24 presents the overall distribution of these types, taking into account every utterance of CLASSIFY from all eight lesson observed.

Figure 24. Overall distribution of *complete, partial* and *implicit classifications*



The pie chart illustrates that a striking 82% of all instances of CLASSIFY can be categorised as partial classifications, with a total count of 60 utterances. The remaining share of CLASSIFY divides up into implicit classifications, accounting for 11% (8 instances), and complete classifications, constituting only 7% (5 instances).

Thus, although providing the most precise information about class and members, *complete classifications* were least frequently implemented among all types of CLASSIFY. This apparent avoidance of complete classifications might have two possible reasons. First, their level of complexity is higher than those of partial classifications, meaning that a closer and more precise understanding of class and member is required. Another reason for the lack of this classification type might be that partial classifications are easier to articulate causing realisers to leave out a basis of classification simply for reasons of convenience. Despite this general avoidance of complete classifications, the following instances, presented by examples 35a-e could be found in the observed data. Each of these five classifications includes information about the basis of classification, which clearly distinguishes them from partial classifications. The basis of each classification is **highlighted** to make them easily recognisable.

Example 35.

a. T: So what's ‚Brownian motion'? This is a physical process, ah, because all **the molecules they have energy**, all the particles have energy.
b. T: there are different kinds of solution and let's say three types of solutions, when it comes to **concentration.** We have three types of solutions....Uh type one would be an isotonic solution.
c. T: So ja basically there are multiple characteristics like hair colour, eye colour and so on which are actually uh where **multiple genes are responsible.**
d. T: So this is, what kind of energy is ATP?
   Sf: {Ahm...}
   T: {It's a}, it's a **chemical compound**, so we call this energy?
   Sf: Ah, it's chemical energy? (laughs)
   T: Yeah, yeah, the chemical energy.
e. T: So, what about Huntington's disease? Yes.
   Sm: Not sex-linked.
   T: Not – ; how do you know that?
   Sm: Ahm, because there **are both males and females involved**.
   T: Yes and dominant or recessive?
   Sm: Dominant.

Given that complete classifications are a rather rare phenomenon, and considering the fact that students were rarely ever urged to specify their classifications, example 3.e is of special interest. In this short sequence, the teacher encourages a student, who just classified 'Huntington's disease' to justify the classification and causes the student to provide the basis for the uttered classification.

The second type of CLASSIFY, also rather rarely found in our corpus of eight observed lessons, are *implicit classifications.* According to theory discussed on this type of CLASSIFY (e.g. Trimble 1985), it provides extended classifying information since the basis of classification is included. Despite the advantage of providing precise information, implicit classifications are characterised by a complex structure and the information given often has to be inferred from text and context. Thus, since class and members are not presented in a straightforward manner, listeners are required to infer the classifying information themselves. The analysis of our data brought forth 11 instances of implicit classifications, 4 of them presented in examples 36a-d.

Example 36.

a. T: In the case, in the case of human beings if we talk about skin colour for example, or body size uhm the issue is uhm slightly more complex though it also follows the same rules your body size is not only determined by one factor. But, by multiple factors, by several factors and in addition to that body size also de is determined by the environment how is your upbring, how good is the food that you eat how many ??? are there and so on.
b. T: And I think diffusion is a process-, we'll see that happens in nature, in all organisms, and we'll, maybe some examples might occur to you, we had diffusion last year, in which processes? So it's natural, you wouldn't use it in plants or on your own body, a catalyst, to speed it up.
c. T: so in gas exchange, whether it's in lungs or in the skin in the moist skin or in gills
d. T: but it takes place in cells. In in in in our cells, in animal cells, in plant cells

As observable, none of the presented classifications presents information in classifying terms, which demands the reader to infer class and members from context. Regarding the integration of information on the basis of a classification, theory and practice appear to differ. Example 36a and b are the only instances of implicit classification found in all eight lessons that provide information on the basis. In example 36a, 'body size' is classified as a 'multifactorial trait' and a basis is provided by stating examples and mentioning that it is 'determined by multiple factors'. Example 36b illustrates the classification of 'diffusion' as being a 'natural process' by stating that 'no catalyst speeds up the reaction'. Since all the other examples do not feature any kind of information about the basis of classification, based on our findings precise implicit classifications appear to be a rather rare phenomenon. Of course, the overall number of observed implicit classifications is relatively low, which is why there is a definite need for further empirical study, which might support these assumptions.

The remaining type of classifications, *partial classifications*, is by far the most frequently occurring type of CLASSIFY of our data and simultaneously shows the simplest linguistic realisation. The most common phrase structure encountered with this classification was a simple *X is (a) Y* structure, like presented by examples 37a-c. An even more rudimentary realisation is presented by examples 37d and e which exemplify that in some cases not even a verb is needed for expressing the relation of two items and classifying them. This characteristically uncomplicated sentence structure might most probably be the reason for the remarkable popularity of partial classification compared to all other types.

Example 37.

a. T: fresh water is a hypotonic solution.
b. T: So purple is a so called a dominant characteristic
c. T: An organism which is cap– big P big P is homozygous, and an organism which is little p little p is homozygous.
d. T: gamete, sperm and egg cells
e. T: phenotype, a hundred percent purple and tall.

However, although numerous instances of this classification type showed such simple linguistic realisation, occasionally more complex structures and phrases were used to utter partial classifications. Table 23 summarizes the most common linguistic realisations of partial classifications besides *A is (a) B,* further exemplifying them by presenting observed instances.

Table 23. Linguistic realisation of *partial classifications*

Linguistic realisation	Example
A is an example of B / B…for example A	T: photosynthesis, that’s an example of diffusion T: Now listen; albinism is an example of a so-called recessive condition. T: Now; blood groups are an example; They’re an example of so-called multiple alleles and co-dominance.

A is a kind / a type / a form of B	T: Diffusion is a type of passive transport T: It's $KMNO_4$. You remember the formula? Ah, Nicki? Sm: Type of crystals. T: Ah, yes, it's a type of crystals
There are … types / forms of B Names of As	T: there are three types of solutions, isotonic solutions… T:there are uhm certain forms of inheritance called incomplete inher- uh incomplete dominance

Certain vocabulary seems to be common for expressing a more complex and sophisticated partial classification, since special words appear frequently among these three types of realisations. The most frequently word used for expressing classifications, encountered in the course of this study, was definitely *example,* followed by the words *type*, *form* and *kind*.

8.1.2. Purposes of classifications

Like already discussed when the theoretical framework for this thesis was introduced, CLASSIFY is an important discourse function, since like Trimble puts it, classifying is "basic to human thinking" (1985: 85). The purpose of this CDF, namely structuring concepts and integrating them into existent systems (Kröss 2014: 15), appears obvious and quite understandable. Nonetheless, when looking at the material studied for this thesis, there also appear examples, whose purpose goes beyond this plain and obvious function which is usually ascribed to classifications. Owing to this observation, we will have a look at the different functions of CLASSIFY, including the obvious and very common one, as well as the unusual and at times concealed purposes of this CDF.

Indeed, most instances of CLASSIFY found in the observed data function in an ordering and structuring way. They either clarify which members belong to a certain class due to special similarities they share, or they point out and determine the class to which one special member belongs. This bidirectional character of the structuring function of CLASSIFY has already been described by Trimble (1985: 85) and Widdowson et al. (1979a: 75), whereby as mentioned before, the latter describe these two types of realisation operating 'from the specific to the general' and vice versa. Thus, classifications with a **structuring purpose** might be realised in two different ways, one of them presented by example 38.

Example 38.

> T: So this is – , what kind of energy is ATP?
> Sf: {Ahm…}
> T: {It's a} it's a chemical compound, so we call this energy?
> Sf: Ah, it's chemical energy? (laughs)
> T: Yeah, yeah, the chemical energy.

This classification uttered in cooperation of teacher and student is characterized by classifying a specific member and stating its general class, thus in Widdowson et al.'s (1979a: 75) terms a classification working 'from the specific to the general'. The teacher brings up the molecule 'ATP' and wants the students to classify it in terms of 'energy types'. The student then declares it to be 'chemical energy', by naming the class this member belongs to. In the set of data investigated, these kind of classifications were realised by using phrase structures, already typically observed before with partial classifications, like *X is a kind of Y* , *X is a type of Y* or *X is an example of Y.* However, in most cases teachers and students made use of very simple structures, like the ones illustrated by the following two examples.

Example 39.

a. T: muscular dystrophy; you said it's a, a sex-linked condition.
b. T: fresh water is a hypotonic solution.

In contrast to classifying 'from the specific to the general', there also occurred instances of CLASSIFY that were organized 'from the general to the specific' like those presented by examples 40a-c.

Example 40.

a. T: Yeah, junctions. Yes, so these cell membranes also have a role in the junctions between, ah, cells. And we said there are different junctions such as the desmosomes.
Sm: And junctions in ???
T: Yes, or charge junctions…So, the proteins within the cell membrane, they also connect cells, especially in animal cells, yes?
b. T: So these would be three new, and nearly the last functions. So, cell-to-cell recognition, support of the shape and cell-to-cell contact.
c. T: Do all organisms breathe with lungs?
Sf: No uhm Kiemen
T: Kiemen, yes who would know 'Kiemen' in English? It's gills. So there is also respiration through gills, it is the same principle and through the moist skin of amphibians, so gills ??? and the moist skin of amphibians … so respiration is always about gas exchange.

While in example 40a, 'junctions between cells' constitutes the general or the class, 'desmosomes' and 'charge junctions' are the special or the members of that class. With example 40b, which occurred subsequently to the previous instance of CLASSIFY, the teacher utters another classification of this kind, stating the different functions such junctions may have. As illustrates by example 40c this type of realisation is often used to underline similarities between the listed members which form the basis of a certain class. Here the teacher mentions different types of 'respiration' and points out that they all belong to one class, since they all include 'gas exchange'. As illustrated nicely by this example, when a need for grouping things and discussing members of a certain group arises, CLASSIFY appears to be the ideal discourse function.

Although apparently a few instances of CLASSIFY that work 'from general to specific' could be detected, in general, classifications that work the other way around were encountered more frequently in the observable data. This apparent tendency towards the first type of classification realisation might have various reasons. On the one hand, the direction of classifications might be influenced by the topic taught, since certain topics rather offer material for either of the two types of classification realisation. When discussing topics like genetics for instance, a lot of genetic conditions come up, which then are most probably classified into categories that describe their modes of inheritance.

Furthermore, different individual teachers and students might also show preferences concerning classification realisation, which consequently influences the direction of classifications.

However, irrespective of their direction of realisation, all instances of CLASSIFY provided above can be assigned a structuring function. As mentioned before, during the course of this analysis additional purposes of classifications, alongside structuring, were found. The following table serves to provide an overview of all these observed purposes of CLASSIFY.

Table 24. Suggested *purposes* of CLASSIFY

Type of purposes	Function
structuring	CLASSIFY is used to order and structure information
clarifying	CLASSIFY is used to clarify mistakes
defining	CLASSIFY is used to elaborate a definition
exemplifying	CLASSIFY is used to provide examples
dividing	CLASSIFY is used to divide topics/lessons into various sections

Based on the analysed data, we could conclude that each classification has at least one of these purposes, but there appeared also utterances that function in multiple ways. If one utterance of CLASSIFY has several purposes, the structuring purpose is, even if sometimes hard to identify, always one of them since structuring and ordering of information is vital to the nature of this CDF.

The **clarifying purpose** of CLASSIFY was found to occur when students mistake items for being something they are definitely not. In such cases, teachers can make use of a clear classification of this misunderstood process or object to correct a student's mistake.

Example 41.

> T: How can diffusion be sped up, by which factors? Think a bit; I'll just have to clean the board, so that it dries in the meantime…Okay, so (T writes on board) the rate of diffusion, meaning the speed of the diffusion. How can it be influenced, which factors, ah, [Sf]?
> Sf: Maybe if you mix it or shake it, or…
> T: **Yes, well, but this wouldn't be diffusion, this would be external energy**, ah, energy supply.

In example 41, instead of stating that the answer given by the student is wrong, the teacher classifies it as not being 'diffusion' but 'external energy', which implies that the student made a mistake but simultaneously categorises the wrong answer to clarify the misunderstanding.

The next purpose of CLASSIFY, which we call the **defining purpose,** is probably rooted in the tendency of CLASSIFY to co-occur with DEFINE. Among the investigated data we found several co-occurrences and in instances comparable to example 42, classifications are used to underline or support certain definitions.

Example 42.

> T: Eye sight, is short sighted, or near sighted*.* Okay? **My phenotype gender is? … Male. Okay? My phenotype concerning is 1,76 meter.** So the phenotype is, is phenotype is actually nothing more than a fancy way of saying what are the characteristics of the organism*.*

The teacher starts a definition of 'phenotype' by providing examples in the form of short classifications. The feature 'male' and 'body size' are classified as 'phenotype' which forms the base of a simple definition. While in this example the classification, strictly speaking, only functions as a trigger, example 43 illustrates that classifications might also be fully integrated into definitions.

Example 43.

> T: Definition; you know, definitions must be exact, so please note:
> **Diffusion is a type of passive transport … Diffusion is a type passive**

> **transport** …ah, comma, usually across a plasma membrane … usually across a plasma membrane…full stop. It is the random movement … It is the random movement … of molecules … from an area of high concentration … to an area of low concentration … until … all the molecules […].

Here the teacher dictates an, as she announces, exact definition of 'diffusion' and starts defining the term by classifying it as 'a type of passive transport'. In this example CLASSIFY clearly has, additionally to its structuring function, a defining purpose.

Another purpose of CLASSIFY observed in our set of data is to give examples of a certain class, while simultaneously categorizing these examples into their superordinate classes. We decided to call this observed purpose of CLASSIFY the **exemplifying purpose**. As illustrated by examples 44a-c, these classifications most frequently make use of the phrase structure *A is an example of B*.

Example 44.

a. T: Yes, photosynthesis, **that's an example** of diffusion.
b. T: Now listen; albinism **is an example** of a so-called recessive condition.
c. T: If give you **for example** there is another sex-linked recessive would be colour-blindness.

This linguistic realisation of CLASSIFY has already been described in the context of structuring purposes of this CDF. Since one instance of CLASSIFY may function in multiple ways, phrase structures that functions in a structural way may as well have an additional exemplifying purpose. In comparison to the other purposes regarding the current data, this is the second most frequently observed purpose of CLASSIFY.

The remaining purpose of CLASSIFY, which we decided to call **dividing purpose**, operates on a more general level than the other four types. In some situations, classifications are realised to divide topics or whole lessons into individual sections, like presented by the following example.

Example 45.

> T: The topic uh for this third of the year core is genetics (T turns to blackboard and starts writing) … okay? and uhm we're gonna talk about

two main parts genetics, of genetics. One of them is called classical genetics (T writes on board) … the second part that we're gonna talk about is molecular genetics … okay and I'm gonna start off with classical genetics.

In example 45 the teacher divides the topic 'genetics' into two different parts by naming the two members of the class 'genetics', which then form subordinated classes. The teacher further clarifies which of the two parts of genetics the lesson is going to start with. Interestingly, as example 46a and b illustrate, the teacher draws on this classification several times in the course of the three subsequent lessons.

Example 46.

a. T: Mendel.
   Sf: That belongs to classical
   T: That's classical genetics now, okay?
b. T: so I will give you a whole bunch of worksheets
   Sm: Yeey!
   T: Relating to classical genetics.

First, the teacher classifies an arising topic as belonging to one of the two constituted sub-classes, in order to guarantee that students know how this topic is related to the main class in general. Later, worksheets are handed out and it is again clarified that their content relates to the sub-class 'classical genetics'. Thus, by dividing the main topic into sub-classes one can easily classify and relate different topics which might arise.

The five functions resulting from the analysis of our material do most probably not address all possible instances of CLASSIFY occurring in a CLIL environment. Thus, further empirical research is necessary and might bring forth additional purposes a classification might fulfil, and could verify to which extend the proposed functions are actually implemented if an extended set of data is consulted. Nevertheless, different ways of implementing CLASSIFY become apparent and also the co-occurrence of some of the functions could be observed.

8.1.3. Realisers

Like observed with most CDFS, CLASSIFY was mostly realised by teachers, uttering 52 of all 73 classifications. Nevertheless, the TS-realised instances of CLASSIFY were the most interesting utterances in terms of internal structure.

As Dalton-Puffer (2013: 240) mentions, previous studies on CDF realisation in a CLIL context revealed that “overall discourse organisation makes it easy for students to avoid having to verbalize anything but tiny snippets of [CDFs]”. A teacher providing nearly all the relevant information and expecting students to merely stating the name of a class or a class member is a phenomenon regularly observable with classifications found in the recorded data. Such co-realised classifications are presented by examples 47a-c.

Example 47.

a. T: Transport across membranes. And we were talking about which form of transport? Which two big forms of transport are there. [Sf]?
b. Sf: We were talking about passive.
c. T: So, here, when we talk about look, are we talking about the genotype or the phenotype?
   Sf: The…phenotype.
   T: The phenotype.
d. Sf: Maybe if you walk somewhere, but if you…
   T: Yes, is this passive or active?
   Sf: Active.
   T: Active transport.

In example 47a the utterance of a partial classification is triggered by a T-realised question which already hints towards certain class members the teacher expects the student to name. This causes the student’s part of the co-realised classification to be rather simple and to some extend predetermined by the teacher’s question. Examples 47b and c exemplify situations in which even less individual classifying work is carried out by the students, since the teacher already provides two possibilities for potential classes. Such behaviour is also described by Lackner (2012: 97), who reports that his investigated set of data mostly features TS-realised classifications, for which teachers ask questions and students simply answer these questions by naming certain items of classification. Hardly ever do students utter a classification independently and without being requested to do so by the teacher.

8.2. DEFINE (Hofmann)

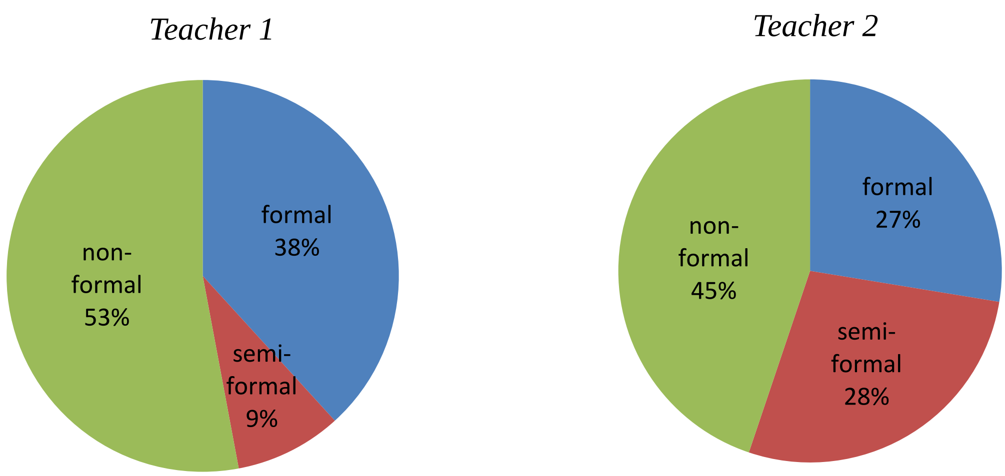
8.2.1. Types of definitions

As outlined in the theoretical chapter on definitions, the CDF type can either take the form of *simple* or *complex* definitions, which again are divided into other functions.

Simple definitions

Simple definitions contain three sub-types, as has been outlined in the theoretical presentation; *formal*, *semi-formal* and *non-formal* definitions. The utilisation of these three types varies across lessons and, accordingly, across the two teachers. This can be observed in figure 25.

Figure 25. Distribution of *simple definitions* across teachers T1, T2



The total number of simple definitions that were coded in the corpus data is 62, out of which 34 were performed by T1 and 28 by T2. Non-formal definitions make up exactly half of the occurrences in the lessons of both teachers put together, perhaps owing to their imprecision and minimal set of requirements. It is probable that non-formal definitions are more likely than the other forms to be uttered without the realiser's actual intention to perform a full definition, thus taking both little time and attention to be articulated. Their practicability therefore renders them a useful and frequent tool to overcome comprehension problems and seems to equate their lack of structure and precision, that is, at least in the view of the realiser, or in the context of their concrete application.

The second-most number of instances could be identified among the formal type of simple definitions, the total occurrences amounting to no less than 21, which is quite striking given their complex nature. An explanation could be their indispensability for certain key-terms which needed specification and deliberate defining to make possible the required level of technical understanding from the students' part. After all, the two lesson-quartets constitute complete thematic units, including an introduction with all necessary technical terms. It would be interesting to observe the usage of definitions if the thematic units continued and stretched into longer episodes; in other words, whether formal definitions would actually become a less frequent phenomenon, because the relevant key-terms had already been properly defined in the beginning.

The final and least-frequently encountered type of simple definitions are semi-formal definitions. Although they make up only 9% of T1's lessons, they do account for little less than a third of T2's definitions.

Formal definitions:

Definitions are considered formal if they include beside the term also the class and the difference that distinguishes it from any other member of the hypernym. This full form of definition has been coded various times in the corpus and may, according to our understanding, be separated into two categories according to their complexity and purpose: the first couple of examples below (48a-c) are instances where the teacher presents a fully-elaborated definition with the intention to be noted down in written form by the students and, by extension, to be memorised and recalled in case of a test situation. This was in fact the case after the teacher's utterance in 48b, when a student was requested to define *osmosis* in the next lesson. Such 'fully-fledged' definitions seem often to be announced on a meta-level, as in 48a-b, which suggests an intention from the teacher's side to mark them as particularly important and highlight their status in contrast to other, non-announced, definitions. Example 48c is in this case a border-member of the group, not being directly named on a meta-level, but nonetheless its potential value for the students' academic future is articulated. A notable feature of example 48a is the descriptive characterisation of definitions as usually being 'exact'; this case will, however, be addressed in more detail in the section about meta-talk.

Example 48. [all T-realised]

a. definition; you know, **definitions must be exact**, so please note: diffusion is a type of passive transport…Diffusion is a type of passive transport…ah, comma, usually across a plasma membrane…usually across a plasma membrane…full stop. It is the random movement…It is the random movement…of molecules…from an area of high concentration…to an area of low concentration…until…all the molecules…are equally distributed, full stop
b. so osmosis is**, the definition is**, the diffusion of water molecules, is the diffusion of water molecules, through a semi-permeable membrane, down the concentration gradient of the water molecules
c. the characteristics which are seen or which are expressed he called or are called phenotype. So maybe you want also write this down somewhere. [writing on board]...and the phenotype, in German 'Phänotyp', **in case some of you have to know it for some kind of a university admission exam**.

The other type of formal definitions is less or even non-explicit about their formal purposes. Their function lies largely within the context of the utterance in that they provide necessary information about key-terms for the progress of the lesson. Their mention is not of a very deliberate nature, but rather in passing, focus being placed not on themselves but on the meaning of the terms they seek to clarify. What also becomes evident at the inspection of examples 49a-e is their much shorter length compared to explicit definitions.

Example 49.

a. T: muscular dystrophy is a condition where the muscle starts to develop back
b. T: so, what about the rh-negative and rh-positive; this is an additional blood group factor which is inherited independently
c. T: define sex-linkage. Sex-linkage is when? [Sf].
   Sf: ahm, it's a condition that's, uhm, more common for a certain sex
d. T: in eukaryotes, these are all organisms that have a nucleus
e. T: in the ovaries and in the testis. Okay? The parts of the sex organs which are uh those sex organs which are actually responsible for making the gametes

In summary, we would suggest the classification of simple formal definitions into two categories: *explicit* and *non-explicit*; an overview of these is given in table 25.

Table 25. *Explicit* and *non-explicit* formal definitions

Type of formal definition	Function	Characteristics
Explicit	extended, academic function	high complexity and precision announced on a meta-level intended for annotation in written form and memorisation
Non-explicit	immediate, contextual function	low complexity and precision not announced on a meta-level intended to give information crucial for the lesson progress

Semi-formal definitions:

What has been addressed in the theoretical part about semi-formal definitions is that they are characterised through a class-omission: either the class is left out because it is considered obvious or because it is too populous in membership for inclusion. The corpus data clearly indicate that the first of the two reasons is the major one. In fact, every single semi-formal definition lacks the class of the term due to the redundancy of its explicit mention. An observation worthwhile is that in most cases the withheld class is some form of (biological) **process** or **state**. It would indeed be interesting to know if such classes of processes are likewise omitted in other natural science lessons, such as physics or chemistry. Examples 50a-c are such cases where the class '(type of) process' is left out, and examples 50d-f where the class '(type of) state' is omitted.

Example 50.

a. T: so in gas exchange, whether it's in lungs or in the skin in the moist skin or in gills, it's always O_2 crosses the membrane in one direction and CO_2 in the other direction and it's always along a concentration gradient
b. T: so in other words meiosis is the formation of gametes
c. T: uhm, in cell respiration uhm the the O_2 and and and glucose is used to ATP molecules
d. T: so isotonic means, something has the same concentration. Uh meaning same concentration…on both sides of a membrane
e. T: What does a concentration gradient mean? Uhm [Sm1]…That on o- in one part of the solution or one part, there is…or [Sm2].
   Sm2: There is a high concentration of {this}
   T: {yes}
   Sm2: and in the other it's lower and it falls
f. Sm: I just wanted to ask if hypotonic is when there is less pressure outside?
   T: Yes, less concentration

As far as the context of realisation goes, one may discern from the above examples that semi-formal definitions do not normally appear at the initial mention of a new technical term. Much rather are they part of a kind of interim résumé which aims to repeat something that has already been explicated, mainly for revision or clarification purposes. A lexical feature that supports this observation is the recurrent emergence of *so* (examples 50a-b, d), which marks the starting point of a recapitulatory sequence, similarly to *in other words* in example 50b.

A conclusion on semi-formal definitions from the corpus data may look the following: semi-formal definitions often

1) *have a process or state as class which is regarded as obvious and hence omitted*
2) *have a summarising function*

Non-formal definitions:

The third kind of formal definitions is the least precise type, providing information in terms of synonyms, or, as has been mentioned in the theory, by hypernyms which are taken for synonyms. This 'wrong' synonymy has been detected no more than twice throughout the entire corpus data (see examples 51a-b), which may be a sign of the teachers' generally high awareness of the hierarchical relationship between a class and its members.

Example 51. [all T-realised]

a. alleles are [kinds of] factors
b. [kinds of] immune cells of the body, the white blood cells

The large remainder of non-formal definitions are real synonyms and can be divided into two types, depending on the term they aim to define. In the first type definitions are handled as instruments for the clarification of **technical, subject-related** terminology. The principal motive behind their realisation is the term's absence in everyday speech, which calls for a 'translation' into a more common language so as to ensure accessibility of its meaning. Note that the level of syntactic complexity varies across instances: in examples 52a-c the synonym is merely added without any statement about the specific relation between the two related terms, whereas in examples 52d-h this relationship is deliberately expressed with the phrases *is the same as/are also known as/are referred to as/that's* and *means*.

Example 52. [all T-realised]

a. filaments, protein fibres
b. fertilized zygote, fertilized egg cell
c. the thylacoid, the stack of these membranes
d. mitosis, that's regular cell division
e. hybrid is the same as heterozygous
f. so this is hypotonic, means less concentrated
g. dihybrid crosses uhm are also known as two-factor crosses.
h. and non-sex-linked, uhm, characteristics, are referred to as autosomal.

The second type of non-formal definitions is similar in length and form, but differs in the kind of terms they seek to define (see example 53). While the previous type is concerned with technical terms, this one is comprised of more **common, non-subject-related** vocabulary items which are likely to be part of everyday language. As such, their main function is not to clarify technical terms which are bound to be unknown to the students, but to bridge potential gaps in the learners' English competences. It is little surprise, then, that the latter kind of non-formal definitions appeared exclusively in T2's lessons, where it is expected that students have a generally lower level of language competence than the students of T1, which have been confronted with English as the medium for instruction in all subjects from lower-secondary onwards. It would be interesting to know whether this observed correlation between learners' competence level and language-related non-formal definitions was generalisable if larger amounts of data were at hand, or rather, if few instances of such definitions can serve as a reliable indicator of students' high language competence level. Likewise, the amount of content-related definitions may be an indication of learners' level of subject-related expertise.

Example 53.

a. T: it's foreign, it doesn't belong
b. T: decreases, yes. Okay, so it's lower
c. T: they support it, they help to…give its form
d. T: the rate of diffusion, meaning the speed of the diffusion
e. T: diluted means? Wisst's ihr das noch? Ja?
   Sf: less concentrated?

As has been done with formal definitions, our suggested sub-types of non-formal definitions are presented in a table below.

Table 26. *Content-related* and *language-related* non-formal definitions

Type of non-formal definition	Type of term	Function
Content-related	technical, subject-related	The synonym may help overcome comprehension problems arising from learners' insufficient subject expertise * may indicate learners' subject competence

Language-related	common, part of everyday speech	Thy synonym may help overcome comprehension problems arising from learners' insufficient language competence * may indicate learners' language competence

Complex definitions

Leaving simple definitions behind and turning to complex definitions, only two of the three varieties could be detected in the corpus. No *operational* definitions were found in any of the eight lessons and *stipulations* occurred no more than four times, all of them realised in T1's lessons. *Explications* were encountered throughout most lessons and amount to a considerable total number of 26 instances. They were relatively evenly distributed among both teachers, T2 accounting for little more than half of the occurrences.

Stipulations:

What becomes evident from the uneven appearance of stipulations in the corpus is their dependence on the topic of the lesson. We argue that stipulations are unlikely to find their way into the Biology classroom, as few topics require the formulation of stipulations. Mendel genetics apparently is one of these rare instances, and indeed all four stipulations have been verbalised in relation to inheritance patterns, which call for the need to stipulate alphabetical letters as representations of dominant or recessive alleles of inheritable traits. In the TS-realisation in example 54c the teacher even initiates the stipulation by using the word *define* on a meta-level, drawing attention to the formal relevance of the subsequent passage.

Example 54.

a. T: capital 'A' is the allele for normal skin colour, which we consider dominant…And lower-case 'a' is the allele for albinism.
b. T: in the case of muscular dystrophy, let's use 'M' as the allele. Let's use 'M'.
c. T: We need to **define** our alleles, right? The the letters the the the ??? right? So which uh uh I will tell you right now, that purple and tall are

dominant and they are in this case they are mono– monohybrid. So we're going to use which letters? Would you suggest for purple, I mean, let's use the one from yesterday, right? Big 'P', right? The big 'P' is allele for for for purple. And, so what are you gonna use for the white allele?
Sm: small
T: the small 'p', right? And what allele or whatever would you suggest for uh for the colour, uh not for the colour, for the size?
Sf: 'S'
Sm: big 'T'
T: big 'T' I would say, okay? So big 'T' is the allele for the tall plant and what is the allele for the short plant?
Sm: small 't'

Explications:

By definition an explication may vary considerably in length (Trimble 1985: 83) the explicatory part might be no more than a single word in form of a synonym of the term to be defined, or the explication might stretch to an entire conversation, as in example 56. The three examples 55a-c are short explications not exceeding a mere synonym: in 55a the synonym is provided in form of a translation, in 55b the term *sex cells* is further specified into sperm and egg cells, and in 55c the prefix *hypo-* is clarified through a non-formal definition.

Example 55. [all T-realised]

a. so, when there is an area of high concentration and one of low concentration, we call this, there is a concentration gradient. Ja, ein Konzentrationsgradient
b. meiosis is the making of gametes. Sex cells. Sperm and egg cells.
c. uhm when the concentration outside is less. So the second possibility is, this is called, hypotonic solution. Hypotonic solution. 'Hypo' means less.

Quite a different form of complex definition is presented in example 56; here the explication of *meiosis*, the kind of cell division that results in the formation of the gametes, stretches over several turns between the teacher and various students. The passage in fact is so extensive and complex it contains a series of other shorter and longer CDF realisations, among them formal and non-formal definitions, classifications, purpose descriptions, short teacher reports, evaluations and TS-explorations, and as such constitutes a nice example of a

DEFINE-episode. All these embedded cognitive discourse functions serve in a broader sense as supporting devices within the larger complex definition, but also have their very own, specific function, inherent to the CDF type they form part of. For clarity purposes only instances of DEFINE have been marked bold, while other CDF types have not been highlighted.

Example 56.

> T: but we did not talk about meiosis. Okay? So that's the thing, we did not talk about meiosis, because over here ??? So listen exactly, so listen people. In your….in living things, **in eukaryotes, these are all organisms that have a nucleus**, uhm cell division of course, involves a movement of chromosomes, and in mitosis, the purpose of mitosis is that we produce two genetically identical cells.
> Sm: in meiosis there is a crossing over
> T: yes, so we have in mitosis, the purpose of **mitosis, that's regular cell division**, is to produce two cells, which are the same. Purpose, produce or form two genetically identical cells.
> Sf: and that's in asexual reproduction?
> T: for example in asexual reproduction, this is important, for example during growth or development this is important because when you're small you grow then you need more cells. These cells have to divide.
> Sm: so that's the one that's more common
> T: I wouldn't say uhm huh...
> Sf: like in the body
> T: ja, let's put it this way, I don't like the word more common, because it depends on how do you define common, I mean, meiosis occurs everytime when organisms form gametes for reproduction, and this happens, okay? But uh, so the point is is that mitosis is more common in the sense that more cells in the body are involved in mitosis.
> Sf: ja, okay
> T: okay? So that is basically, I would say, a regular normal cell division again. I know what you're gonna say of this, [T1] what is regular, what is normal? Okay, what is common, you would ???? In Meiosis, is entirely diff– it's not, it's somewhat different. The purpose of meiosis is is to form genetically different cells. So purpose is to produce genetically different cells with half of the DNA. Okay? So it is the purpose is to produce genetically different cells with half of the DNA. So in other words **meiosis is the formation of gametes. Sex cells**. That is the the that's the purpose, and I would like to ask you, in your body, where does mitosis occur?
> Sm: everywhere.

T: hm? Where does it occur? Mitosis
Sm: everywhere!
T: ja, everywhere, where we have normal cells, obviously. And where do we have meiosis occurring?
Sm: uhm, sex organs.
T: where? Sex organs are ??? and large
Sf: it's not in the sex organs
T: in which part of the sex organs?
Sf: is it in the womb of the woman
T: no, not in the womb of the woman, not in the womb of the woman. In the ovaries and in the testis

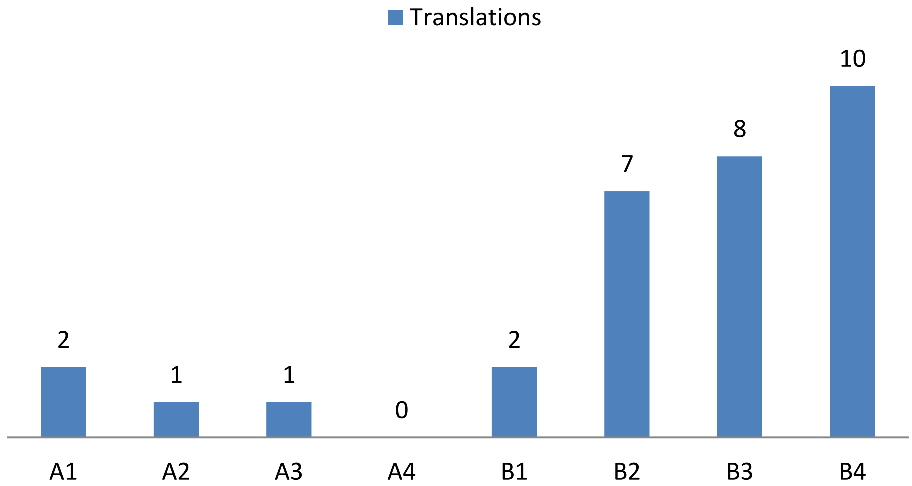
A short summarizing comment about explications would involve the following aspect: complex definitions by explication either are

1) *very brief, the explication being comprised of no more than a synonym*
2) *very extensive, constituting a DEFINE-episode and containing other CDF types which have a supportive function, as well as their own type-related function*

Translations

Translation of unfamiliar terms into the students' L1 language is yet a further type of definition. Infamous as they may be both among teachers as well as CLIL specialists, that does not make them appear less often during lessons. Concerns are of course with good cause; translations may offer a solution to the students' immediate comprehension problem, however, they do not guarantee that the learners have actually fully grasped the semantic dimension of the translated word; after all, students at the age of fifteen to eighteen are far from having access to the total repertoire of biological, historical, economical, etc…concepts, even in their own language (this being the main purpose of their continuing education). Apart from this, translations are by no means beneficial to students' attitude to the target language: if translation into the mother tongue is a popular option during class even for the teacher, learners will hardly see a reason to opt for anything else other than the simplest and least challenging solution themselves, not least because they find neither encouragement from their teacher, nor a safe environment to practice other, more sophisticated and linguistically valuable forms. Despite these drawbacks, the concrete practicability of translations seems to be in the foreground in some situations.

Figure 26. Distribution of *translations* across lessons A1 – B4



The contemplation of translation-definitions in the corpus reveals a strikingly irregular distribution (see figure 26): of the total number of 31 translations, not more than four have been counted in the first four lessons, A1 – A4, while in T2's lessons, B1 – B4, the remaining majority of 27 are found. The interesting question at this point is the following: is said uneven emergence of translations due to the different teacher styles of T1 and T2, or due to a different language level of the students, or due to the distinct subject contents of the two lesson quartettes?

At a closer look into the contexts of the recorded translations it is possible to distinguish several kinds of purposes of their realisations. In examples 57a-c translations serve the teacher as a tool to provide the students with specific and necessary information about a key term which has immediate relevance for the progress on the content

Example 57.

a. T: and the solid is called solute, das ist der gelöste Stoff
b. T: funnel. Ein ein Trichter.
c. T: do you know what semi uhm what semi means? [SM]?
   Sm: uhm halb
   T: halb, yes, and permeable means

Sm: durchlässig
T: durchlässig, wonderful

If the teacher hadn't given the translation in the above examples, he/she would not have been certain whether the students would indeed be able to understand the content that followed. In the above cases, therefore, any kind of elaboration on the presumably unknown terms was an indispensable move from the teacher, whether the elaboration is performed as a simple translation or an explication in the target language is another issue.

The next two examples 58a-b are quite a different case. Here the teacher translates two terms into German, although in the strict sense students would be able to follow the teacher's report and even perform activities by themselves without the translations: the larger context of the utterance tells them that Huntington's disease is a sex-linked condition and muscular dystrophy is inherited as a dominant allele. The primary reason for these translations cannot be the immediate necessity at the moment of performance, but is likely to be found in the value of the German terms for the students' facilitated association with the concept to possibly existing previous knowledge.

Example 58. [all T-realised]

a. and Huntington's is also known in German as Veitstanz
b. Muscular dystrophy is a condition where the muscle starts to develop back. Okay? Muskelschwund.

Yet another set of translations is about words which are in German as equivalent to their English synonyms as could be. In the light also of the considerable size of this set one might puzzle over the purpose of such translations, which are neither necessary for students' comprehension, nor would they cause students to access their previous knowledge, as the German words are either equally unfamiliar due to their technical nature (see examples 59a-c) or they are part of everyday speech (example 59d).

Example 59. [all T-realised]

a. uh type one would be an isotonic solution. In German 'isotonisch'
b. this pressure from inside now is called turgor pressure, der Turgordruck

c. the phenotype, in German ‘Phänotyp’, in case some of you have to know it for some kind of a university admission exam
d. what is genetics? ‘Genetik’ in German

Example 59c hints at a possible reason for the German translations, which is their potential requirement for any kind of natural science test in the students’ academic future. In another instance one of the two teachers directly address the issue of English terms and their German translations in the context of the CLIL classroom, reporting that other teachers (apparently not part of the CLIL programme) have complained about students’ lack of technical vocabulary in German.

> Das haben die Kollegen ein bisschen von den Supplierstunden gesagt, dass ihr dann sagts ihr wisst‘s das nicht auf Deutsch, oder ihr könnt‘s das nicht auf Deutsch. Bitte schon uh ich geh schon davon aus, dass ihr das auch auf Deutsch erklären könnts, weil ich ja immer wir schreiben die deutschen Begriffe ja auch meist auf. Ja also das heißt es sollte euch schon auch möglich sein das auf Deutsch zu erklären. Wenn’s irgendwo Fragen gibt bitte wisst‘s eh immer stellen. Oder wenn ich einen Fachbegriff nicht auf Deutsch sag aber wir schreiben‘s ja eigentlich immer in den Korrekturrand. Das heißt also das sollt passen.
>
> [That’s what also the colleagues from the substitute lessons said, that you say that you don’t know something in German, or that you can’t do it in German. Please, I do assume that you can also explain this in German, because I always we write down the German terms in most cases. Yes, so this means it should also be possible for you to explain this in German. If there are any question please, you know, just ask. Or if I don’t state a scientific term in German but actually we always jot them down on the margin for correction. That means that should work out.]

A substantial number of translations was also found to be made in the opposite direction, that is, from students’ L1 into the target language during German episodes. Here again at least two reasons can be identified: the first is to give the students a deliberate lexical input because the word is deemed useful or crucial for their competences in English (example 60a-b), while the second is connected to the teacher, who may in the concrete situation find the English term elusive to his or her memory, and therefore states it first in German and then attempts a translation into English (examples 60c-d).

Example 60. [all T-realised]

a. who would know 'Kiemen' in English? It's 'gills'.
b. 'diluted', ja das brauch ma immer wieder. 'Verdünnt'.
c. 'Bestreben', weiß ich jetzt nicht, the 'tendency', yes
d. and you can u- you could also use a an ein Osmometer, or 'osmometer' in English, I think it's the same word. Osmometer [English intonation].

In the entire corpus there was only one single instance where the teacher requested an English explanation/definition of a word from a student (see example 61). The student first gives the German translation, but the teacher is not satisfied and proposes that the student should embed it in a situational description.

Example 61.

T: so the next thing, cell to cell recognition. What's to recognise somebody? How would you explain this? To recognise somebody, or something? Hm, [SF]?
Sf: jemanden zu erkennen.
T: Yes but could you explain it in English, maybe?
Sm: Ah, well, ah…
T: You can give a situation for example.
Sm: When you see someone on the street and then you think ah he's familiar and then, ah, I know…
T: Yes, okay, yes; that's recognition. And this also happens to cells.

In summary, five different functions of translations have been identified in the corpus data; an overview is presented in table 27.

Table 27. Functions of *translation* in the CLIL classroom

Direction of translation	Type of function	Description
English to German	*Contextual function*	The German term may help clarify the meaning, which has immediate relevance in the lesson
	Associative function	The German term may help students associate to their previous knowledge
	Academic function	The German term may be required at a test in the students' academic future

German to English	*Competence function*	The English term may be crucial for students' language competences in English
	Explorative function (T)	The English term is used by the teacher to suggest or attempt a translation

Turning to the question of which factor is responsible for the decisive distribution of translations in the data, content, teacher, or student, we doubt that a straight-forward answer is at hand. Teacher methods and preferences do certainly play a role, as some translation functions were performed solely by one of the two teachers, for instance the contextual and explorative function just by T2 and the associative function just by T1. A possible explanation for the minimal number of translations in T1's lessons could be the students' high level of competence in English, given their being in year 12 as well as their exclusively English education from lower secondary onwards. As such, translations for contextual functions might not have been necessary, whereas in T2's lessons the students required, or were at least thought to require, more translations to be able to tackle the content.

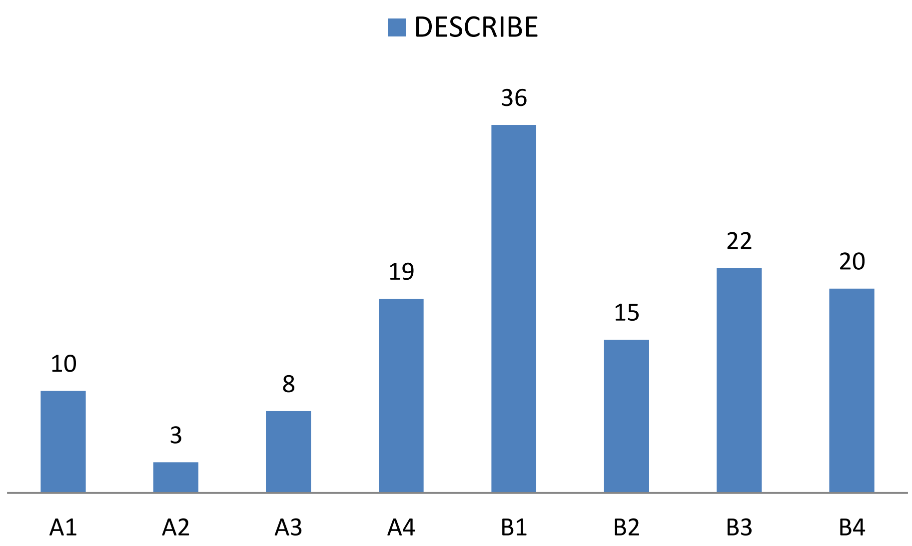
8.2.2. Realisers

Results in the domain of realisers point to a clearly T-dominated CDF type. Teachers also seem to be the kind of realiser prone to utter more complex forms of definitions. S-realisations, on the other hand, beside being very small in number, centre around the more open types of definitions which are less bound to a predetermined structure. While verbalisations made both by the teacher and one or more students occurred within all types, what needs to be borne in mind in this respect is the unequal division of labour, so to say, between both realisers, teachers in most cases supplying the more decisive parts of definitions.

8.3. DESCRIBE (Hopf)

As already discussed as part of the quantitative analysis of CDFs, regarding overall counts, DESCRIBE is the most frequently implemented CDF. Looking at individual lessons separately, varying tendencies, presented by Figure 27, unfold.

Figure 27. Distribution of DESCRIBE across lessons A1 – B4



Definitely observable, the high count of DESCRIBE instances roots in the frequency of occurrences of this CDF in Teacher 2's lessons (B1-B4), which account for almost 70% of all descriptions found in the recorded data. Since, in the course of her study, Kröss (2014) also found inconsistencies concerning the distribution of DESCRIBE across lessons, this might not be mere coincidence but caused by a certain factor. When looking for a reason for the strikingly one-sided distribution apparent in the currently observed data, one has to take a closer look at the structure and content of the different lesson quartets. Such analysis brings forth three factors that might explain the large amount of occurrences of DESCRIBE in Teacher 2's lessons.

1) **Topic:** Since both lesson sequences consisting of four single lessons are concerned with very diverse and by no means comparable topics, one might assume that the high frequency of DESRIBE in lessons B1-B4 is caused by the content taught.

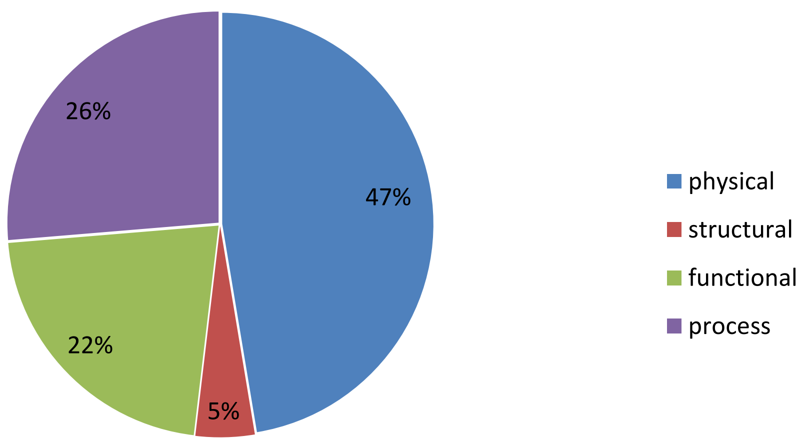
2) **Methods:** Revisions that summarize content of previous lessons are a constant part at the beginning of Teacher 2's lessons. Topics are revised via teacher-initiated dialogues and in the course of this process DESCRIBE seems to be a common mean for revising content. This kind of summarizing TS-talk is only rarely found in Teacher 1's lessons.

3) **Preference**: Although DESCRIBE realised in co-operation of teacher and students appeared more frequently than it was the case with CDFs like CLASSIFY or REPORT, most instances were still teacher-realised. Thus, the individual teaching style of each teacher can render differences, meaning that the high number of DESCRIBE in Teacher 2's lesson might also originate from the teacher's preference for this CDF.

8.3.1. Types of descriptions

Based on the information provided by literature discussed in former chapters, DESCRIBE might be divided into four subcategories. *Physical, structural, functional* and *process descriptions* all provide different types of information and can, in most cases, be clearly told apart. Figure 28 illustrates the distribution of these four types of DESCRIBE as percentages, taking into consideration all eight observed lessons.

Figure 28. Distribution of types of DESCRIBE



Having a look at the pie chart, one instantly recognizes that physical descriptions represent the highest share of DESCRIBE, accounting for 47% (63 instances). About a quarter of occurrences can be attributed to each, process descriptions (26%) and functional descriptions (22%), leaving structural descriptions, with only 5% of total occurrences, as the least frequently occurring type of DESCRIBE.

Physical descriptions

In general, physical descriptions are concerned with physical characteristics and spatial relations of certain objects, additionally including features like for instance shape or colour of the objects in question (Trimble 1985: 71). The high number of utterances of this description type found in the investigated data indicates its importance concerning biology lessons. Note that knowledge about an object's physical characteristics is most often needed to understand functions or processes, these objects are involved in. Therefore the description of processes like osmosis would for instance be impossible to understand if students had no knowledge about the physical characteristics of a bio-membrane. Thus, different types of descriptions are well distinguishable but nonetheless a certain correlation and dependence is observable.

When having a closer look at individual examples of physical descriptions, further possible categorisations of this type become apparent. Every example of physical description presents **information** about the visible features of an object in question. The attempt to categorize the presented information brought forth three different types of features presented by physical description.

A lot of descriptions are concerned with **characteristics** like the shape, sizes, colours temperatures or concentration and thus, describe the physical features of an object itself. 28 out of 63 examples of physical descriptions found in the current data provide information which might be classified as a characteristic, four of them presented by examples 62a-e.

Example 62.

a. T: We've got a glass cylinder. It should be clean but it isn't, sorry. I have some hydrochloric acid to clean it but it wasn't available., it's filled with water; it's clear water…Yeah well the water is clear, but it's only the cylinder isn't clean, so that's a problem. And I've got some wonderful crystals here
b. T: it's purple crystals
c. T: So these gases are quite small molecules
d. T: the X-chromosome is quite large
e. T: So what we do observe, that all the solutes, is distributed equally now.

Another quite large number of physical descriptions, accounting for 21 of 63 instances, provided information about an objects place in a certain space, or spatial relations of different objects. This **spatial** information is most often linguistically implemented through the use of prepositions of place like *on*, *in* (examples 63a-c) or *next to* but also adjectives like *attached to* (example 63d) are fairly common.

Example 63.

a. T: Insulin is in the blood, it's everywhere; it's in contact with many cells
b. T: so that's the carbohydrate chains…on the outside of the membrane
c. T: In which part of the sex organs?
   Sf: Is it in the womb of the woman.
   T: No not in the womb of the woman, not in the womb of the woman. In the ovaries and in the testis
d. T: And they, ah, must attach somewhere, and they're often attached to these protein; membrane proteins.

The third type of information provided by physical descriptions is concerned with important **components** that relate to a certain object in a specific way. The frequency of occurrences of this information type was the lowest of all three types, while accounting for only 14 of 63 instances. Nonetheless some physical descriptions provided only information about a certain component which the described object contains. Although content-wise quite similar, they are not to be mistaken for structural descriptions, which describe the structure of an object by naming all relevant components while physical descriptions only describe one special component.

Example 64.

a. T: And this U-tube has got a semi-permeable membrane
b. T: In human sperm and human eggs you only have not twice the information but only once.
c. T: Now in one of these there is a solution with a solvent
d. T: And also over here, these chromosomes over here have different genes arranged in the same sequence.

To sum up, based on the analysis of our material, the information provided by physical descriptions might be classified into three main categories according to the features they are concerned with. Table 28 is supposed to provide an overview of the different information types and their frequency of occurrence in the recorded material.

Table 28. Information provided by *physical descriptions*.

Type of information		**Frequency of occurrence in %**
characteristic	Describes visible features of the object like colour, size, shape, concentration, temperature, etc.	33%
spatial	Describes the spatial position of an object or the spatial relation to other objects.	22%
component	Describes object by naming one important component of it.	45%

Another factor for classifying physical descriptions regards their level of preciseness. When looking at the examples presented for each of the different types of information provided by physical description, it can already be observed that certain descriptions are more precise than others. Example 63a , in which the description 'it's everywhere' is extended by adding 'it's in contact with many cells', can be considered more specific than for instance example 63b, in which the teacher only names the unspecified place 'membrane' when describing the carbohydrates' locations. As mentioned in chapter 5.3., Trimble (1985: 71) discusses this distinction of **general** and **specific physical descriptions.** According to him, only descriptions providing detailed data on for example distances, numbers or concentrations can be considered specific. Based on Trimble's understanding of specific physical descriptions, the eight observed lessons only featured 4 descriptions of that kind, each of them presented by examples 65a-d.

Example 65.

a. T: in a distance of 1.5 meters
b. T: and in the case of blood groups we have three alleles
c. T: Alveoli. You remember they are only one cell thin, so it's very, the membrane is very thin, and so oxygen can diffuse into … These alveoli … they are, they are surrounded by the capillaries
d. T: Physiologische Kochsalzlösung. Uh this would be about 0,9% NaCl.
e. T: So the receptors are found only on specific cells and they bind only to specific substances.
f. T: So this has a, a specific concentration this cell sap.

Interestingly, even though specific descriptions are rather rare, teachers often mention *specific concentrations* or *specific cells*, like in example 65e and f, without ever really specifying the object in question. The reason for the small number of specific descriptions might probably again root in the convenience of realisers. If not essential and indispensable, realisers do not bother to add specific information to a physical description. Furthermore, too much or even redundant specific information might overwhelm listeners and impair comprehension. In sum, these factors cause most physical descriptions to be uttered in a general manner.

One further noticeable aspect about physical descriptions is that they always either aim to describe an **abstract** object or one that is **actually observed** while described. In other words, either there is an object which is actually observed by both interlocutors while being described, or an abstract object, of whose shape, size or colour only one interlocutor is aware is described to inform a listener about its features. When physically describing actually observable things in the course of the observed lessons, realisers were most often referring to drawings on either the blackboard or worksheets, like illustrated by examples 66a-c, or to objects involved in experiments, as in examples 66d and e.

Example 66.

a. T: When you see this drawing or this sketch with the membrane, ah, the plasma membrane protein and these filaments.
b. T: The funnel is down here uh and we have a semi-permeable membrane that covers the open end of the funnel, funnel (T writing on board) Funnel, and this is a semi-permeable membrane. So that's the s- das mach ma auch noch grad. So the pure water is over here. ??? in the water. And the funnel is filled with a sugar solution.
c. T: Uhm, you see circles and you see squares, and some of these circles are coloured and some of these circles are…some of these boxes are not coloured.
d. T: At the bottom, so here we have an area of high concentration. Whereas on top, [Sm]?
   Sm: This is the area of low concentration.
e. T: A similar experiment: I've got a glass of water, it's cold water by the way, it's from the tap.

As can be observed, descriptions concerning objects visible for listener and speaker show a rather low level of explicitness and make little to no use of academic language or precise terms of description. Students and teachers express physical descriptions by using demonstrative pronouns like *this* and *these* and describe spatial relations by using the unspecified adverb *here* in *over here* or *down here,* for instance. Phrases like *here we've got* and *here you see* aim to indicate that the listener can have a look at the described object. Since listener and realiser both observe the described object, there is apparently no need of precise and explicit descriptions, as observed when abstract or unknown objects are described. Lackner's study (2012: 74) also revealed a high number of physical descriptions realised in an inexplicit manner, but while he only refers to student realised descriptions the material analysed for this thesis revealed that there is no significant differences between students and teachers if visible objects are described.

Structural descriptions

The fine line between structural and physical descriptions caused for instance Trimble (1985) and Dalton-Puffer (2015) to include this type of descriptions into physical descriptions. For the current study we nonetheless decided to present it as an individual category, since we felt that it potentially could be an important part of biology lessons in particular. The frequency of structural description seems to highly depend on taught content, since not a single utterance of that kind was found in Teacher 1's lessons but 6 instances can be reported in Teacher 2's lessons. Some topics demand special knowledge about the structure of certain objects and thus the relationship of a whole object and its parts. This is why cell biology cannot be taught if students are not aware of the different parts of a cell, and the different parts of the nervous system need to be known before we understand how information is processed. The following examples 67a-d, observed in Teacher 2's lessons indicate that certain topics indeed trigger the use of structural descriptions.

Example 67.

a. T: What's the cytoskeleton made of; could you name any part of the cytoskeleton; maybe [Sf]?
   Sf: Ahm, filaments…intermediate filaments and the microtubules.
   T: Yes, so different filaments, protein fibres
b. T: I think we must repeat what's a solution made of, the parts of a solution. If you remember from fourth form, a solution is made up of, a solution forms (T writes on board) What do we need to make a solution? Ah, [Sm]?
   Sm: A liquid and a solid.
c. T: So I got the lungs and which structures within the lungs, that take up the oxygen? Through diffusion?
   Sm: Bronchioles.
   T: not the bronchiole but on the bronchiole there is uh this bunch of bunch of? Alveoli, yeah, so in the lungs we have the alveoli, diese Lungenbläschen.
d. Sf: And it's uh a solute and a sol-
   T: Mhm, often yeah. When it's a liquid then it's a solute and a solvent uh and what happens?
   Sf: It becomes a solution.

4 out of 6 structural descriptions were uttered in collaboration of teacher and students. As Lackner (2012: 52) describes, structural descriptions are realised in two different directions, either the whole object is named first, followed by

the parts it consists of (67a-c), or the parts which form a special object are listed (67d). Although the first type definitely appeared more often in our set of data, note has to be taken of the small amount of instances found regarding this type of structural descriptions, which does not permit us to make any justified general claims.

Functional description

As mentioned in the discussion of relevant literature, functional descriptions can either describe the function of a whole object, process or condition, but they can also describe the function of separate parts of this whole item. A close analysis of all functional descriptions occurring in the observed set of data revealed that most functional descriptions concern whole items that occur in the course of a lesson, and whose function is immediately described. Examples 68a-d illustrate this description type, which was found to be uttered by teachers only.

Example 68. [all T-realised]

a. Osmometer. And it can be used to measure the uh, the osmotic uh to measure the osmotic pressure of the solution. Osmometer measures …the osmotic pressure … of a solution.
b. And this U-tube has got a semi-permeable membrane that separates these two, two parts of this glass vessel.
c. the purpose of sexual reproduction. One of sexual reproduction is to make sure that every generation is different.
d. The purpose of meiosis is is to form genetically different cells.

Regarding this issue, one of T1's lessons discloses interesting material regarding functional descriptions, while simultaneously providing the highest amount of this type of DESCRIBE in one single lesson, with 17 out of 30 utterances. The lesson in question is the only teaching sequence in which several descriptions concerning the function of individual parts of a whole object appear. No other lesson features this type of functional description exemplified by the following examples. Example 69a illustrates the description that triggers the subsequent sequence of functional descriptions of single parts. The object 'bio-membrane' is here described in cooperation of teacher and student and followed by functional descriptions concerning the individual parts relevant for the 'bio-membrane', all resembling those presented by examples 69b and c.

Example 69.

a. T: So can anyone give a role of a membrane? How about, yes, ahm, [Sm]?
   Sm: Ahm, it controls and regulates the exit, enter and exit of the, ahm, of the cell.
   T: Yes, of the substances that, ahm , go into and out of the cell. Yes, and …
   Sf: And separates the cytoplasm from the extracellular flourid and the cell organelles from the cytoplasm.
b. T: What do receptors do?
   Sm: They take in substances
c. T: What does the substance do? With what – ; we're talking about hormones; for example for insulin. Insulin is in the blood, it's everywhere; it's in contact with many cells, ah, but some of them have got receptors, they –
   Sm: Ahm, they trigger a specific reaction.

Descriptions of the function of "cytoskeleton" and "carbohydrate chains", all being relevant for the function of a bio-membrane, could also be found in this teaching sequence. The descriptions, regarding functions of different parts of an object, were most probably employed to support the description of the whole object 'bio-membrane'. This hypothesis would explain why no individual functional description of a single part was found in any of the eight lessons.

Further differences occur when the linguistic implementation of functional descriptions in both lesson quartets is observed. Lackner (2012) discusses two different types of functional descriptions, presented by Figure, depending on the linguistic structures they are realized in.

Figure 29. *Functional Description* Type 1 and 2, adapted from Lackner (2012: 53)

Type 1:

The A One	function purpose aim objective role	of the	*whole/part*	is to	*function*

Type 2:

whole/part	serves to is responsible for performs the function of controls regulates	*Function*

Even though it is not possible to classify each functional description observed as either Type 1 or Type 2, most instances could be assigned to one of them. Interestingly, not one of Teacher 2's descriptions shows the sentence structure presented by Type 2, while on the other hand almost every functional description uttered by Teacher 1 was realised in this manner. Examples 70a-d are supposed to exemplify the linguistic realisation of Type 1 descriptions, as uttered by Teacher 2 (70a and b), as well as Type 2 descriptions found in Teacher 1's lessons (70c and d).

Example 70.

a. T: So, this would be fibers…of the cytoskeleton. And as they attach on inside of the cell membrane, they support it; they help to…give form.
b. T: if we have two cells; these carbohydrate chains, they function like tags.
c. T: The purpose of meiosis is is to form genetically different cells.
d. T: But generally the point of, the point of sexual reproduction is to increase genetic variability.

On these grounds, we can argue that the linguistic realisations of functional descriptions presented by Lackner (2012: 53) are indeed observable and apparently their occurrence is highly influenced by the teacher's personal preference.

Process description

The last type of DESCRIBE is concerned with the different steps a process is constituted of. The analysis of eight observed lessons disclosed that certain conjunctions are a common part of verbally realised process descriptions. To link individual steps of a process, mostly rather simple coordinating conjunctions like *and* or *and then* are used, while *at first* frequently initiates such a sequence of steps. Subordinating conjunctions on the other hand like *as long* or *until* are employed to indicate the end of a single step. Interestingly, by uttering introductory phrases like the one presented by example 71e, teachers more often announce process descriptions in advance than any other type of descriptions.

Within the scope of the analysed material, process descriptions were found to occur in three different contexts. They might be concerned with a process that is **actually being observed** at the moment of description, they can also refer to a process which is only **theoretically described** in the abstract or they are used to give **instructions**. All three possibilities are illustrated by examples 71a-e.

Example 71.

a. T: And I'll put some of the crystals very carefully in here. Only some, but I don't mix it, I don't stir it
b. Sf: The uhm uh water of the low concentrated solution goes to the high concen- high concentrated solution and then the water level rises and the salt solution dilu- {T: dilutes} dilutes. {T: Yes} Yes.
c. T: Yes, that's the process…of digestion where it's broken down into; what did we say last year? Proteins are broken down into? Aminoacids. Yes, and they're taken up by the microvilli … ??? ... By digestion you get the building blocks, the aminoacids, and they are taken up into the blood and brought to the cells and they need it; these, ah, building blocks, aminoacids, to make from these aminoacids your own proteins.
d. T: No, not the insulin changes to glucose, no (laughs). The insulin binds to the receptor, to the insulin receptor. And what's the process that's triggered by this, ah, binding? Ah, [Sm]?

Sm: The glucose carrier opens and takes in glucose from the blood. T: From the blood, into the cell

e. T: So what we are now going to do, what you are going to do now is the following. This is now the next, next big thing. We're now going to make the next cross, and we are going to cross a big P little p big T little t, a purple tall plant, however heterozygous for both characteristics. With another big P little p big T little t, another purple tall plant. Good and I'm going to make another four by four matrix and you have to do the following again. Look at this, this here, this here, this here and this here.

Examples 71a and b represent descriptions, uttered while the actual process is happening, 71c and d on the other hand only describe theoretical concepts of processes which happen everywhere in nature but are not observable at that very moment of description. The first type of process description, describing actual processes, typically occurs in the context of experiments. Either the person carrying out the experiment describes the single steps of the experiment, or an observer communicates the perceivable steps of the process. The third context calling for a process description is created by giving instructions, like exemplified by example 71e. In contrast to the other two types of process descriptions, those implemented for giving instructions are not primarily concerned with biological or academic content, but with the procedure of the exercise they are addressing. They for instance, describe a process necessary for the completion of a certain task or exercise, like presented by example 71e, in which the teacher ensures that all students understand how to approach a certain genetic cross. Overall, the number of descriptions operating as instructions was by no means tremendously high, but it might be interesting to find out if this number would rise if the general number of instructions uttered during the course of a lesson would be higher.

8.3.2. Realisers

Previous studies on discourse functions in CLIL lessons by Lackner (2012) and Kröss (2014) revealed that DESCRIBE is characterized by a relatively high frequency of TS-realisations. Although most descriptions found in the data and used for the current study were still realised by teachers only, a total amount of 21% of DESCRIBE was uttered in co-realisation, which is a quite high number compared to co-realisations of REPORT, EVALUATE or CLASSIFY. Like example 72a-c illustrate, these descriptions are often triggered by teachers, who ask for certain information and hence motivate students to contribute.

Example 72.

a. T: You remember, ah, we had the phospholipid bilayer, and we said on the outside of the bilayer; what's attached on the outside? To the lipids and to some of the proteins; what do we find attached, ah, [Sf]?
   Sf: Carbohydrate chains.
b. T: membranes act as, or parts of the membrane, the membrane proteins act as; [Sm] act as?
   Sm: Ah, receptors.
c. T: What are, what are the basic building blocks of the plasma membrane?
   Sf: The ahm …
   T: They have a hydrophilic head and a hydrophobic tail. What do we call these molecules? The phospho-?
   Sf: Lipids.
d. T: It's difficult. But I'm sure you can explain the experiment?
   Sf: Okay, so at first we put $KMNO_4$ in it. That's potassium permanganate, ahm the crystals, they sank down.
   T: You put it in water, m-hm.
   Sf: Yeah. So, ah over time they diffused, and –
   T: Are they-, yeah, but what could we observe? Yes, you could observe that they started to dissolve and at the end of the lesson?
   Sf: It was just a little bit purple on the bottom and it wasn't like it was just on the bottom, but it was up in the middle, so, and then went farther and farther up.

Students add simply structured sentences, sometimes even only words, which operate as describing information. They avoid uttering whole sentences to express descriptions and in cases like they are illustrated by example 72c, teachers provide almost the whole description, only motivating students to complete it. A lot of these co-constructed descriptions occurred in the context of revisions, which, as mentioned before, seem to trigger the use of this CDF. Thus, these types of co-constructions can definitely be classified as teacher-driven since students usually only participate when asked to. Descriptions realized autonomously by students or in voluntary co-construction are rather prompted by experiments like the one presented by example 72d. During this TS-realised description the student almost autonomously describes an experiment with only limited support provided by the teacher.

8.4. EVALUATE (Hofmann)

8.4.1. Differentiating between *judgments* and *evaluations*

The difference between EVALUATE and mere judgements has already been outlined in the theory about evaluations: while evaluations are always supported by a frame of reference, that is, any kind of justification based on the realiser's knowledge in the area, judgments are made without such provision of a reason which would legitimise its content. In order to have a quantitative comparison of judgments and 'real' evaluations at our disposal for further interpretation, both of them have been marked throughout our coding process.

Figure 30. Distribution of *judgements* and *evaluations* across lessons A1 – B4

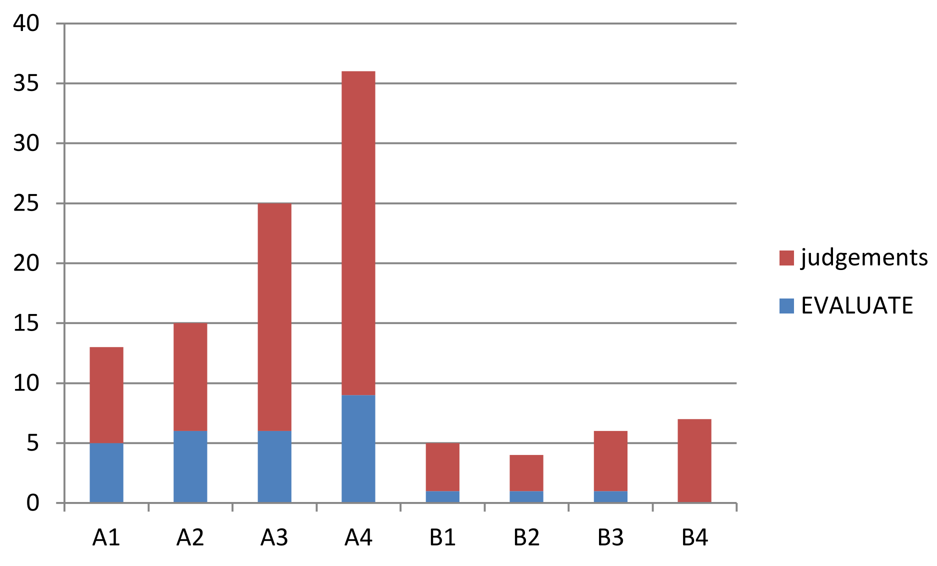


Figure 30 shows the distribution of judgments and of real instances of EVALUATE across all lessons from T1 and T2. The first observation that clearly deserves our attention is the uneven distribution of total amounts of judgements, including those which are evaluations, across the corpus. T1's lessons account for 89 instances, while T2's lessons account for a comparatively feeble amount of 22 realisations, which is no more than a fourth. Moving on to the two types of judgments themselves, namely those with and those without justification, it is clearly visible that the amount of those without justification is higher in each of the lessons, but in much greater a number in T2's lessons than in those of T1. The average amount of judgments is 10 per lesson while the mean of evaluations is between 3 and 4 realisations. If more data were available that followed a similar pattern, it would be interesting to know if this calculation might actually lead to the formulation of the general rule of thumb that every third or fourth judgment made is also an instance of EVALUATE. The strong prevalence of judgments that were uttered without the addition of any kind of grounding clearly demands a speculation as to the reason for this circumstance. A plausible explanation may be found in their form: in the light of their lack of a justification they are simpler in form and thus more easily, so to say, phraseable. This hypothesis is perhaps best supported by the distribution of realisers: all but 4 instances of EVALUATE have been performed by the teacher, who is expected to be familiar with the necessity of justifications in evaluative statements, while only 4 instances have been performed by TS and one by S alone. As concerns the vast discrepancy of instances of judgments and evaluations between the two teachers, it is our conviction that not only the different teaching styles of T1 and T2, but to an extent also the topics of the two lesson quartettes play a considerable role. Bearing in mind the explorative nature that prevails within the topic of Mendel genetics, independent of the number of EXPLORE-occurrences as such, and the predominantly descriptive nature inherent in the topic of transport across cell membranes, again independent of the actual number of occurrences of DESCRIBE, it is suggestive that the first one will trigger more incidents of EVALUATE, as it probably gives rise to a variety of incidents which naturally entail evaluations about, for example, the probability of a certain condition to appear within a family, or the chance for a certain genotype of a parent, or about the advantages or drawbacks of a specific system in use. Descriptions, meanwhile, seem to make an environment less prone to involve evaluations, perhaps because their function is to relate visible or abstract facts, which do not give much room for judgments.

Before taking a closer look at the characteristics of 'real' evaluations, a brief list of examples of judgments without justification is provided in order to illustrate the difference between the two types. All examples 73a-g involve a judgment that is being verbalised either about a likelihood (example 73a), difficulty or complexity (examples 73b-e) or feature of interest (73f-g). Naturally, judgments can be made about many more criteria; the ones from example 73 are simply those which have been encountered repeatedly throughout the corpus. Contrary to real evaluations, these instances lack a justification based on any kind of frame of reference.

Example 73.

a. T: well, let's put it, let's put it this way. If you ask me, I think everything is possible in nature.
b. T: I guess counting is the most difficult thing, right?
c. T: and the challenge is to translate the instructions into a cross
d. T: I think blood group B is also quite easy
e. T: oh that's a very sophisticated answer
f. T: and the second thing which I kind of, ahm, consider a little bit interesting is, is, is, that basically the man who kind of marries in, yeah, also, also is an albino
g. T: There is no pigment present to cover up the, the colour of the blood.
   Sf: That's so cool.

8.4.2. Justifications

Turning to 'real' evaluations, that is, all instances which belong to the CDF category EVALUATE, a relatively frequent phenomenon that has been detected in our corpus is the co-occurrence of causal explanations, their function being to support realised evaluative statements with evidence. In other words, these causality explanations provide a grounding to evaluations which is based on reason and argument. From the range of conjunctions expressing such causal explanations only one single type has been found within evaluations, *because*. Such explanations accompanying evaluations will again be dealt with in the subsequent chapter about EXPLAIN.

Example 74. [all T-realised]

a. I don't know, **I would already say it's a disease because** it's really degenerative

b. **this is important because** when you're small you grow then you need more cells
c. uhm when organisms reproduce...that the next generation is somewhat different in...than the parent generation, **this is really important because** otherwise the species would not be able to adapt to a changing environment
d. this one has a strong historic importance. Okay, and it's, ahm, **also very useful because** it actually shows a very clean and clear type of inheritance.

The four above examples illustrate the combined realisation of EVALUATE and EXPLAIN. Note that the criterion upon which the evaluation is being performed is the same or similar across utterances 74b-d. In fact, many of the coded evaluations have been found to center around a few basic criteria, which are broached repeatedly throughout the data. Most of these criteria have already been pointed out in the theoretical part about evaluations, namely 'importance', 'certainty', and the range between 'good' and 'bad'. There is one other which has been identified to a great extent across all eight lessons, which is the criterion of difficulty. Teachers frequently comment on the level of difficulty of a certain topic, exercise, case, etc…Whether such comments are mere judgments or full evaluations with justifications is dependent on the necessity of such a justification. In other words, in most cases the clarity of the context renders an explanation superfluous and hence the judgment cannot be counted as an instance of EVALUATE.

In fact, a close inspection of the characteristics of evaluations centering around these different criteria has yielded a few insights as to the co-occurrence with explanations: while judgments about difficulty are usually not accompanied by justifications, the context generally providing enough information and the teacher a sufficiently professional voice to support the utterance, judgments about certainty and importance are more often supported by an explanation, such as in example 75.

Example 75.

> T: yeah, and here, for the mother; **we're a little bit uncertain**; of course we cannot completely exclude the possibility, but generally we would say it's rather unlikely that somebody…if you have a condition which is

> travelling in a family, and you have somebody marrying in; it would be a big coincidence if this person would also be carrying the allele…Unless there's some kind of indirect family relationship, I don't know, several generations back, which you are not aware of.

A plausible reason for the inclusion of justifications in evaluations about certainty is the complexity of the meaning they seek to convey; in comparison to judgments about difficulty, or even importance, those about certainty may be longer because they entail a presentation of a series of circumstances which eventually give rise to a statement about certainty. It is not surprising that the evaluation about certainty in example 3 is verbalised partly in a modality tone to underline the explorative nature in which the uncertainty is expressed.

8.4.3. Types of evaluations

Reverting to the distinction made between *checking* and *critiquing*, it has been found that the second of the two is far more frequent than the former, all above extracts being examples of 'critiquing'. In numerical terms, incidents of 'checking', meanwhile, have been identified only five times throughout the whole corpus, while all the rest constitute examples of 'critiquing'. The major difference between them is their internal and external nature, respectively, which has already been outlined in the theory. The fact that 'critiquing' focuses on one, and seldom more than one, 'outer' characteristic, whereas the emphasis in 'checking' is on the inner consistency of a system, process, or circumstance as a whole, renders, in our opinion, the latter one a greater challenge for proper realisation. What is more, the necessary environment for 'checking' is bound to appear less frequently, as the 'internal' structure of something can only be evaluated once and as a whole, while its 'outer' characteristics can be evaluated across a large series of criteria, such as the ones mentioned earlier. One example of 'checking' has already been stated in the theory; the remaining four are given below.

Example 76. [all T-realised]

a. well you are thinking that's actually like maths. Ja. It's like problem solving like maths. Might not be as abstract or as difficult but some of you are actually thinking that's uh I don't know there's some kind of a **mathematical system** or mathematical rule behind the whole thing.

b. first of all, the **blood group system**; because of its multiple alleles it's very convenient. It gives you more possibilities, so for this reason it has been used or still can be used to determine, actually; is this my child or not?
c. please do not use the following **writing system**. Some people; also at the Matura and so on, and the science; they said, aha they use ABO. And they said that the three alleles are A, B and O. These are my three alleles. No, that's wrong. Okay, these are the phenotypes.
d. nice classical issues where you can do a **DNA test**, and where you do not know now; Should I actually get myself tested or not, because my father that or that...and I have a fifty percent chance...and I don't know if I should get tested, because if I'm negative then basically I can be relieved and I can...but when I'm positive and I'm forty-five fifty then I'll start to become more and more demented and I'll start to lose body control, so then at least I know that I have to live my life before that.

A striking observation concerning 'checking' is that in our corpus all five evaluations were made about some kind of system, or, in case of example 76d, a method, if the example from the theory is included. It seems that systems are particularly favourable for evaluation, if compared to for instance processes, which would have given rise to a number of occasions for evaluation in T2's lessons about different kinds of diffusion. A plausible reason for this circumstance may be their distinct source of origin: the systems in the example above are all man-made, eventhough they might be used to describe a biological phenomenon, that is, the blood group system is a tool to describe blood groups, the writing system is a tool for describing patterns of inheritance, etc... Processes like osmosis, diffusion, and other kinds of transport, quite to the contrary, are of biological origin; they are, so to say, made by nature, and, like everything made by nature, thoroughly trialled by a three billion years' history of evolution and natural selection. It is therefore, perhaps, that such biological processes are less prone to be evaluated, given the fact that their mere existence makes them the most effective way of transport across cells there could possibly be. Nevertheless, this does not give an explanation as to why such nature-made processes are not evaluated according to criteria other than net efficiency, such as the time they require to be carried out, the amount of energy needed, etc...

A criterion of classification of such 'checking' evaluations could be its place of manifestation within its larger context. The observation of examples 76a-d leads to the conclusion that in some instances the evaluation of the method, system, or process is presented before and in some cases after the thing under scrutiny has become the topic for discussion in the classroom. If we compare example 76a with the remaining examples 76b-d, this difference should become clearer: before 76a is uttered by the teacher, a long sequence of EXPLORE between teacher and students has taken place in which several inheritance patterns have been worked on in the form of short exercises. The teacher then places his evaluation at the end, that is, as a **concluding** comment on inheritance patterns and the used system to calculate probabilities. In the other instances, meanwhile, the term of the system or method under scrutiny is verbalised in the beginning and followed by an **introductory** remark which takes the form of an evaluation. Three of the four instances (including the example from chapter 5.4 on page 42/43) articulate their initial position verbally: in example 76b *first of all, the blood group system*, in example 76c *please do not use the following writing system*, and in the example from the theory *and now, for multiple alleles [...] we have a writing problem*.

8.4.4. Realisers

What has already been highlighted is the rare occurrences of S- and TS-realised instances of EVALUATE. Like with all but one other CDF types the teacher seems to be the main author, and in the case of evaluations to an even greater extent than in other functions. Given the fact that student-realised evaluations appeared no more than twice throughout the entire data corpus, it will perhaps yield interesting insights to take a look at one of these instances, which is provided in example 77.

Example 77.

> T: yeah, there are some health issues; one of the bigger one is, is sunlight, and some other side-effects as well, but I mean it's, it's...
> Sf: it's not so grave?

T: ??? there are albino associations.
Sf: **they're outsiders....I think...the psychical...**
T: Okay, that is another issue. Okay, so let's move on a further step. Now listen, albinism is an example of a so-called recessive condition.

The teacher presents some of the health issues involved in albinism and wants to conclude that, apart from minor drawbacks, the condition is not life-threatening. Then a student contradicts her/him by stating her opinion that due to their status as social outcasts, they are probably bound to suffer psychological consequences. The student first states the reason behind her evaluation, *they're outsiders*. In a next step she marks the upcoming evaluation as her own opinion by using the phrase *I think*, whereupon the evaluation as such follows, *the psychical*. She doesn't fully utter the evaluation, as it is clear from the context what is meant. Another, or additional, reason, however, could be a lack of self-confidence. As the teacher has closed the matter of 'health issues' by stating his/her phrase about albino associations, and clearly would like to proceed to other matters, the student is fully aware that she is contradicting her teacher by opening the issue up once more and stating her evaluative opinion. Even though we only have one example of student-authored instance of EVALUATE at our disposal, it nevertheless gives a hint in a certain direction: as has already been pointed out in the theory, students seem to shrink back from contradicting their teacher, be it because of the hierarchical relationship at work in classrooms, or because it simply 'feels wrong' for them to pretend to be cleverer than the official expert in the field.

Evaluations appear to be a CDF category where the quantitative as well as qualitative discrepancy of T- and S-realisations is of a particular magnitude. Perhaps it is the subjective and judgmental nature inherent in evaluations that quenches students' willingness for performance, and consequently their realisation is deemed more personal and therefore face-threatening. In comparison, other CDF types centre around the verbalisation of 'safe' facts in whichever way and as a result are handled less carefully.

11.5. EXPLAIN (Hofmann)

11.5.1. Types of explanations

In the following step an outline of all encountered conjunctions, both of *causality* and *consequence* explanations is provided to give an insight into the inner structure of explanations in the CLIL classroom. The main difference between both is the type of conjunctions which relate a cause to a consequence, as has already been outlined in the theory on explanations. Causality explanations put emphasis on the cause of a cause-and-effect situation, that is, on the reason behind a circumstance under scrutiny, while the effect is secondary in the utterance. The purpose of causality conjunctions thus is the relation of the effects back to their causal origin. As such, causality explanations may be compared to a 'backwards' movement. Consequence explanations behave, quite logically, in the opposite way, stressing the effect of a cause-and-effect situation and neglecting the reason or origin of the outcome. Their function is to explain in the 'forward' direction, emphasising the later one of the two stages. In the table below a list of all conjunctions from the corpus, including the ones extracted from secondary literature and outlined in the theory, as well as their frequency, is presented.

Table 29. *Causality* and *consequence* conjunctions in explanations

Type of explanation	Conjunction	Number of occurrences
Causality	*because*	46
	as	2
	since	0
	the reason is	5
	is caused by	2
Consequence	*therefore*	3
	so (that)	15
	if-clauses	10
	for this reason	1
	consequently	0
	that's why	4
	the…the	9
	causes/makes	4

Clearly the first thing that springs to mind at the contemplation of table 29 above is the unequal number of causal and consequential conjunctions, the first type containing 5 members while the latter holds 8 such conjunctions. Nonetheless the causality type constitutes more than half of the total occurrences. What is striking is that nearly 50% of all explanations in total were realised with the conjunction *because*. As such, it reflects a wide preference for its use in causal conjunctions, but it may perhaps also be an indicator for the narrow range of frequently utilised conjunctions in CLIL classrooms. The other two causal conjunctions suggested by Lose (2007: 99) are *since* and *as*, which yield sobering results: the first one was not coded once throughout the entire corpus, the latter no more than twice. That said, it needs to be highlighted that two, previously not mentioned, forms have been added, which occurred various times in our data, namely *the reason is*, and the passive construction *is caused by*. A noticeable observation of these two is that they both feature the type of semantic relation they seek to establish within their forms by including each a lexeme expressing the causal origin of something, 'reason' and 'cause'.

The list of consequence conjunctions is slightly longer and the number of instances per member better distributed. The most frequent realisations were *so (that)* and *if-clauses*, both of which have been mentioned in the theory. The other three which have been stated in the theoretical part, however, are at the rear end in terms of frequency, *therefore* only thrice, *for this reason* once and *consequently* not at all. A possible explanation for the near-absence of these three conjunctions is perhaps their high level of formality, which would not normally find its way into oral discourse. Three other conjunctions have been identified in the corpus which have not been mentioned before; these are *that's why*, *the…the*, and *causes* or *makes*. The first is a quite informal expression which is likely to occur now and then in the CLIL classroom, the third is the counterpart of the passive construction *is caused by*, which belongs to the causality conjunctions. Note that the change of passive to active voice is not only a grammatical shift, but concomitant with a change in the semantic focus of the utterance: the passive construction refers back to the cause, reason, or origin, while the active construction refers to the effect, or result. The second of the new conjunctions, *the…the*, has been found surprisingly often in the data, one is bound to acknowledge. However, this type occurred solely in T2's lesson and only in a very particular context: the teacher had been formulating criteria for the speed of diffusion in the course of an experiment. These criteria all assumed the form *the X, the faster the diffusion*, the cause being 'X' and the consequence being the speed of the diffusion. In this sense, a correlative clause was used to formulate a causal relationship. Apart from these instances, that conjunction has never been encountered.

An example of each of the eleven conjunctions coded in the corpus is provided below, example 78 listing all causality conjunctions and example 79 the consequence conjunctions.

Example 78. [all T-realised]

a.	*because*	and because they do not have a brain, they don't feel embarrassed about it, so they can be monitored without problems
b.	*as*	so there's still movement in here, but as they're evenly distributed, the net movement is zero
c.	*the reason is*	and the reason is evidently my DNA, although I see, we see black hair, uhm evidently I carry the DNA for light hair colours. Okay? Uhm probably from my mother's side
d.	*is caused by*	the rise of the water, the rise in the column is caused by the osmotic pressure

Example 79. [all T-realised]

a.	*therefore*	the body rejects this part because it recognises it's foreign, it doesn't belong. And therefore the immune cells attack this foreign tissue
b.	*so (that)*	you cover parts of plants so that you prevent pollination, uncontrolled pollination, yes.
c.	*if-clause*	if you have actually inner-family marriage, ahm, then you have of course a higher chance of bringing two recessive alleles together which normally, ahm, would not meet each other
d.	*for this reason*	it gives you more possibilities, so for this reason it has been used or still can be used to determine, actually, 'Is this my child of not'?
e.	*that's why*	we know half of your DNA is from your father, half of your DNA is from your mother. Okay? So that's why it's present...also your DNA is pres- present two times
f.	*the…the*	the steeper the concentration gradient, the faster the diffusion
g.	*causes/makes*	the weight of this solution in the column, weight of solution in column, makes uh osmosis stop or uh causes the stop, uh…makes the rise stop

8.5.2. Explanations and other CDF types

In the following step the broader context of explanations will be discussed, above all their connection to other cognitive discourse functions. It has been found that explanations, more than other CDF types, have a tendency to co-occur with certain CDFs which are in their nature likely to trigger instances of EXPLAIN within their own passage of realisation.

EXPLAIN and evaluations

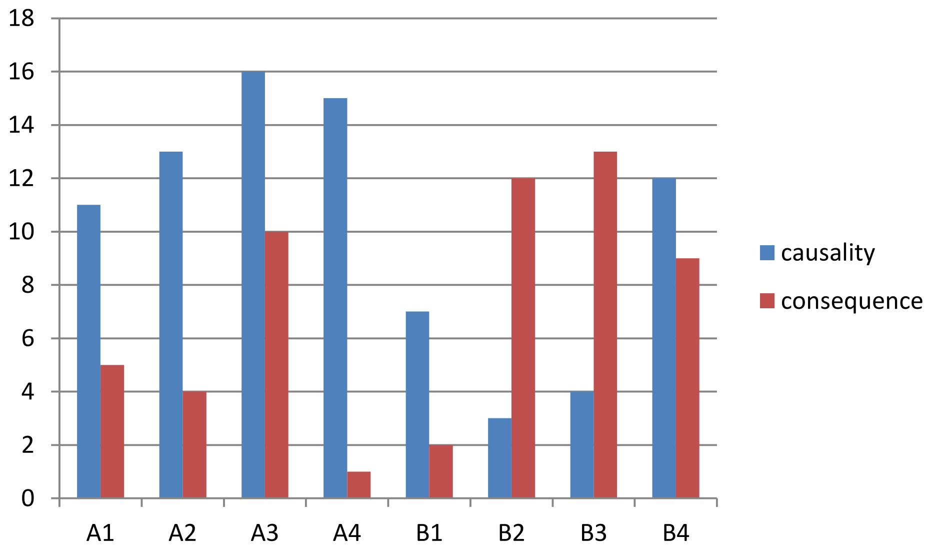
The first notable relation has been detected between explanations and evaluations. As evaluations, by the way they are defined in Dalton-Puffer's CDF construct, always need a justification in order to be set apart from other non-grounded judgements, this requirement is conveniently met by causal explanations. In fact, nearly every single instance of EVALUATE is accompanied by a verbalised reason to support the belief or judgment under analysis, all of which take the form of a causality explanation and all of which use the conjunction *because* (see examples 80a-d). Be it due to the fact that the emphasis lies on the evaluated item, and the supportive explanation is only a necessary prerequisite for the evaluations' legitimate realisation, or due to another reason, the form of the explanation appears not to stand in the foreground and is therefore subject to little to no variation.

Example 80. [all T-realised]

a. I don't know, I would already say it's a disease **because** it's really degenerative
b. this is important **because** when you're small you grow then you need more cells
c. uhm when organisms reproduce...that the next generation is somewhat different in...than the parent generation, this is really important **because** otherwise the species would not be able to adopt to a changing environment
d. this one has a strong historic importance. Okay, and it's, ahm, also very useful **because** it actually shows a very clean and clear type of inheritance.

A phenomenon that must be evidently linked to this prevalence of causal explanations throughout the greater part of evaluations is the uneven distribution of causality and consequence explanations across the eight lessons. Figure 31 below demonstrates that causal explanations outnumber the other type in three of the four lessons of T1 by more than twice the amount of instances, whereas in two of T2's lesson the exact opposite case can be observed.

Figure 31. *Causality* and *consequence* explanations across lessons A1 – B4



The analysis of EVALUATE in the previous chapter gave a quantitative insight into the occurrences of evaluations across both teachers' lessons, the main discovery being a strong prevalence of evaluations in all four of T1's lessons. The formulation of a relationship between said circumstance and the predominance of causal explanations in T1's lessons is thus with good cause and indicate that CDF-overlaps are indeed manifest in the corpus.

EXPLAIN and descriptions

A second connection has been found between EXPLAIN- and DESCRIBE-instances, mainly physical and process descriptions. Descriptions, and their function to unfurl the characteristics of a state or process, appear to create a particularly favourable environment for explanations. Bearing in mind that all biological states and processes have been brought to near perfection through a long history of evolutionary pressure and must in this sense always serve an expedient purpose, it is perhaps little wonder that descriptions of such biological conditions, shapes and processes entail a thoroughly-trialled cause-and-effect grounding. Taking a look at the extracts from example 1, there can be no doubt that one will identify a relation between the physical shape or state of something and the result which is drawn from this condition. In other words, **physical descriptions** are the underlying reason for a subsequent condition (example 81a) or process (examples 81b-d) under scrutiny.

Example 81. [all T-realised]

a. okay, when an allele for a certain characteristic is located on a sex-chromosome. Usually the X-chromosome. Why usually the x-chromosome? **Because** the X-chromosome is quite large
b. the membrane is very thin, and **so** oxygen can diffuse into … these alveoli
c. uhm maybe I should add, uh sugar molecules are bigger than water molecules, they are bigger than CO2, O2, so sugar molecules, we said sugar so they're quite big, **so** they do not pass through the partial membrane, they are held back by the membrane
d. so if it's more concentrated, has it, then it has more water molecules, yes? It has more solutes, salt, lots of salt, sugar, amino acids, whatever. But little or less water molecules. Outside, the tap water has got more w- or has got more water molecules, but less solute. So therefore here is more water. Here is less water. **Therefore** the water travels from the outside into the cell. Into the vacuole, yes? And what does this cause? **This causes** the cell to swell. Yes? The cell swells. Or let's say the vacuole swells

The extracts from example 82 differ from those in example 81 in that they do not link explanations to physical descriptions but to **processes descriptions**. Here, the relation between cause and effect results from within a biological, chemical, or physical process: either the cause is a process and the resulting consequence is another process (example 82a), or the cause is a condition which triggers a process (example 82b), or the explanation does not take the form of a cause-and-effect chain within the process itself but is linked inherently to it (example 82c).

Example 82.

a. Sm: uhm, so the water gets in the funnel
T: Yes, so water molecules will travel in through the semi-permeable membrane into the funnel. So water molecules travel or pass through...through. And **this makes**, as more water molecules travel into this sugar solution, what happens? Can we see something changing?
Sf: yes uh, water in the beaker gets lower
b. Sf: the uhm uh water of the low concentrated solution goes to the high concen- high concentrated solution **and then** the water level rises and the salt solution dilu- {T: dilutes} dilutes. {T: Yes} Yes
T: Okay. Why do the water molecules move from the low concentration of salt to the high concentration of salt?
Sf: **so that** it's equal and...
c. Sm: how do farmers do that?
T: that's basically, I mean I can only tell you what I heard. You gotta take a ladder and you do this, okay? And they have special brushes which actually are there for transferring pollen. **Because** if you don't have enough bees then there is the danger that you don't have any fruits.

EXPLAIN and explorations

Another set of explanations is linked to the CDF-type EXPLORE. In a variety of TS-explorations the main activity is deducing or reasoning from what has been previously learned in order to reach a plausible solution. As would generally be expected if part of an exploration, these instances involve a range of modality expressions, such as *could*, *must be*, *we assume*, *would*, *the only possibility*, *maybe*, and *if…then*. These kinds of explanations occurred predominantly in T1's lessons; a plausible reason for the circumstance is the specific nature of the topic that had been treated: T1's lessons centered around Mendelian inheritance, a field of biology which usually involves deductive work; either the phenotype is deduced from the genotype, or the probability of a certain inheritable condition is calculated for the F1 generation given the parental generation, or a family tree is used to deduce the genotype of an offspring, etc…This format of activities lends itself extremely well to get students' enthusiasm for exploring, deducing and inferring, which is why they are a common part of most Biology lessons which focus on genetics and inheritance. In fact, one of the very few printed sheets that circulated in the course of the lessons was about such type of activities. During the comparison of results the students were always requested to state the reason for which they came to a conclusion about a certain phenotype or genotype. Some of these instances are listed in example 83.

Example 83.

a. T: he must have little 'h' little 'h' because Huntington's is a dominant condition. He does not have it; the only possibility for this is little h little h. Right?
b. T: and if we know they're purple-eyed, we know that already a capital 'P' must be present in each one of them
c. T: capital 'M', right? We assume, because she was actually not part of the family tree, it would be kind of, rather unlikely, ahm that she would also carry the allele.
d. T: so if her own mother had little 'h' little 'h', then her own mother could only have given her daughter a little h.
e. T: so in which, what or what will happen to this cell now? When the solution outside is less concentrated than in-, than inside, [SM]?
   Sm: maybe it let something with uh a bit cell sap outside, that it's uh...that it, that this, that the two uhm that the both liquids get isotonic, or...
f. T: ok, so I would like to ask you the following question. If there are; if there are…parents who have…both have blood-group AB; my parents have blood group AB and I have blood group O
   Sf1: impossible.
   T: then in this case, why? Then I would like to ask you; Did I have another father, or was I adopted?
   Ss: (laugh)
   T: I'm asking. Okay; so I have; basically, my parents, my parents have blood group AB.
   Sm1: you were adopted.
   T: I however have blood group O. Okay, and now I'm asking myself; I'm asking myself, now; was I adopted?
   S1: yes.
   T: or…is my father not my father?
   Sm1: you were adopted.
   Sf2: adopted.
   Sf1: ihr müssts des ausrechnen; hörts auf des zu sagen.
   Sm1: sorry to break it you; you were adopted.
   Sm2: because if both parents, ahm, only have the dominant genotype, you can't come out with two non-dominant genotypes.

T: exactly so this means even, even if my, my, even if my biological father had blood group O; I could not have blood group O. I could not have blood group O. Okay? So in this case I must be adopted

Example 83f is a complete extract of a TS-exploration where the teacher and a few students try to reason about the parentage of a fictitious person. In the beginning the teacher asks the triggering *why?* question, whereupon several students discuss about the possibilities and finally conclude with a reason for their decision. Only example 83e is from T2's data, as is probably apparent from the distinct content.

EXPLAIN and reports

The fourth category of explanations co-occurring with other CDFs are explanations which center around factual knowledge, which links them to REPORT. Of course, what needs to be emphasised at this point is that all explanations contain factual information in a sense, but the manner of their realisation is in the foreground here. After all, explorative explanations are not presented as long-existing facts, but much more like recently 'discovered', so to say, insights or revelations. Descriptive explanations, meanwhile are inherently linked to a physical shape or procedural step which is being described, so again their context is pre-defined and limited to certain occasions. Explanations within the structures of reports are different in that they are independent of a specific contextual form, which is why they look like simple factual explanations, which is why their link to reports suggests itself (see examples 84a-d).

Example 84.

a. T: why are the eyes reddish? Because you see the blood vessels. Okay? There is no pigment present to cover up the, the colour of the blood. {Sf: And the skin colour}
   Sm: Ahm white hair, because they are missing an enzyme.
b. T: that i-if you cross two dogs … with certain characteristics then the baby dogs, the pups… will have characteristics which are similar to the parents
c. T: the body rejects this part because it recognises it's foreign, it doesn't belong. And therefore the immune cells attack this foreign tissue

d. T: you're not allowed to use X, you're not allowed to use Y
Sm: why?
T: but, uh I'm going to explain later, because these are the sex-chromosomes

To sum up the previously outlined types of explanations that have been formulated on the basis of our corpus of CLIL lessons, a table with the description of their function and their characteristics is provided in table 30 below.

Table 30. Types of *explanations*

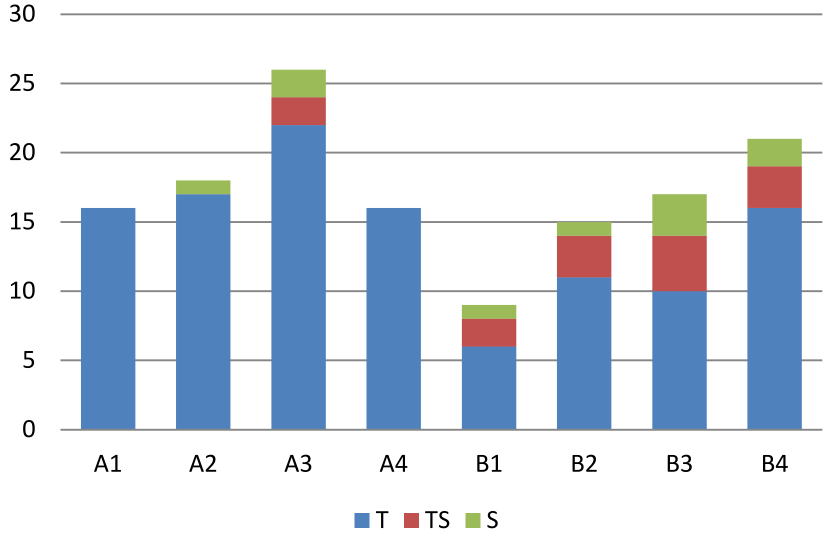
Type of explanation	Function	Characteristics
Evaluative	give reasons for something that is being evaluated	dependent on evaluations, usually realised by either T or S
Descriptive	give reasons for and consequences of a shape, state or process which is being described	dependent on physical or process descriptions, usually realised by either T or S
Explorative	make inferences and deductions about reasons for and consequences of a circumstance which is being explored	dependent on explorations, usually realised by a combination of T and S
Reporting	give reasons for and consequences of a circumstance which is being presented as factual knowledge	independent of context, usually realised by either T or S

A note which needs to be added concerning the above table is that not all explanations may be classifiable according to the four types discussed. These types have been suggested by us because they reappeared in various lessons and across both teachers, and because a significant number of examples were detected, a fact which may suggest their potential for further qualitative analysis of CLIL language. This does not, however, imply that explanations must be either evaluative, descriptive, explorative, or reporting; in fact, future research will probably lead to the formulation of more such sub-types of EXPLAIN.

8.5.3. Realisers

As a final point of analysis an overview of the quantitative distribution of EXPLAIN will be provided. Figure 32 shows the distribution of explanations across the eight lessons and across the three different types of realisers.

Figure 32. Distribution of *explanations* across lessons A1 – B4 and realisers T, TS, S



What becomes evident from the spread of EXPLAIN instances is the uneven distribution of realisers. The fact that most instances were realised by the teacher is no longer a surprising one, this being the case also in most other CDF types. But what is striking is the unequal presence of TS- and S-realisations: 3 of the 4 lessons of T1 do not account for any TS-realised explanation at all, and lesson A3 contains one single occurrence. The haul of S-realisations is comparably meager with only 3 instances in all four lessons. T2's lessons, meanwhile, yielded, at least in relation to lessons A1 – A4, significantly more instances, with 11 occurrences of TS-realisations and 7 by students alone. In lesson B3 nearly half of all explanations were verbalised either by students alone or by a combination of teacher and student(s).

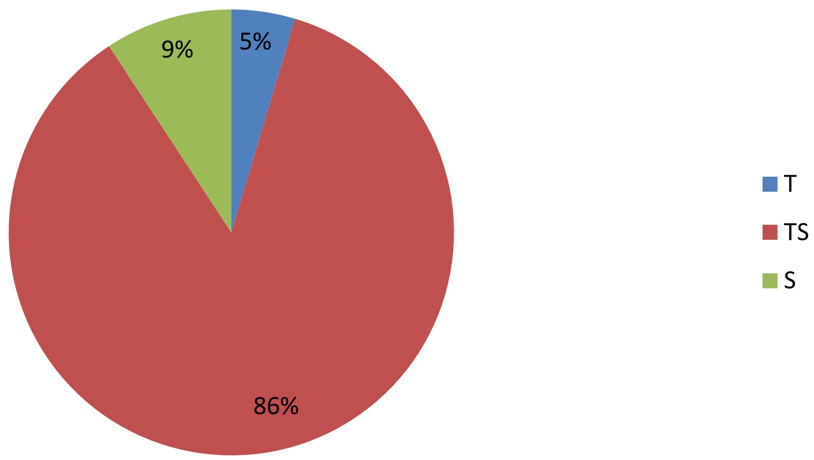
8.6. EXPLORE (Hopf)

Since there are no sub-categories of EXPLORE provided by the reviewed literature, the qualitative analysis of this CDF will concentrate on different aspects. First, special account is taken of the different realisers uttering explorations and observed differences are discussed. A further issue of analysis will be the linguistic realisations of EXPLORE and their role as CDF episodes.

8.6.1. Realisers

EXPLORE is a very special and unique CDF considering its distribution across realiser as presented in Figure 33. In contrast to all the other CDFs, which are in terms of realisation teacher-dominated, EXPLORE shows a strikingly high rate of co-realisations of teachers and students.

Figure 33. Distribution of EXPLORE across realisers T, TS, S



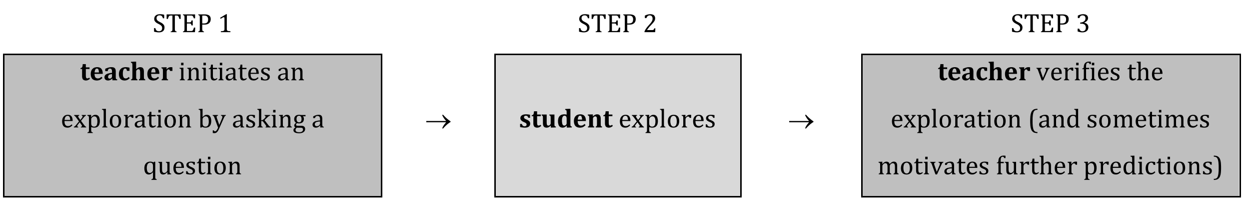
As illustrated by the pie chart, 86% of all explorations uttered during the eight observed lessons were co-realised by teachers and students. Student realisations account for 9% while only 5% of explorations were uttered by teachers. The reason for this very small percentage of teacher-realised exploration is most probably the special nature of this CDF. Having a look at the members of this EXPLORE, which are *speculate, predict, guess, estimate, simulate* and *take other perspectives* (Dalton-Puffer 2013: 235), one might not assume them to be functions typically realised by teachers. Particularly, *guessing*, *speculating* and *predicting* are actions, usually expected to be taken by students, while teachers rather concentrate on presenting or discussing content which they have certain knowledge about. Their main role, considering this CDF, appears to be triggering and validating student's explorations in the case of co-

constructed instances of EXPLORE, which we will elaborate on hereafter. However, even though T-realised explorations appear to be a rather rare phenomenon of CLIL lessons, teachers bear a pivotal role regarding this CDF. A closer look at each of the realisers of EXPLORE and the structures used for implementing this CDF reveals certain similarities among those uttering this function.

Teacher-Student

Most instances of EXPLORE found in the current set of data, which were realised in co-construction of teacher and students, are built on a mutual three-step-structure, presented by Figure 34.

Figure 34. Structure of *TS*-realised explorations



Teachers often try to motivate students to guess or predict by asking them questions, and dialogues, in which exploration takes place, are the consequence. Lemke (1990: 8), who investigates science classroom discourse, too mentions a three-step-structure, which he calls the "Triadic Dialogue". Although his model is concerned with classroom dialogue in general, the third step mentioned by him, "evaluation" (1990: 8), is of greater interest for this study. Lemke (1990: 7) proposes this move of evaluation to not be optional, and as observable in the upcoming examples for TS-realised explorations this holds true for the data observed for this study. He further elaborates on the topic by stating that until the teacher utters a positive evaluation, students will continue guessing and providing possible answers (Lemke 1990: 7-8). Example 85a illustrates such a situation in which a student's reaction to a negative evaluation is to explore further.

Example 85.

a. T: How can it be influenced, which factors, ah, Vivi?
   Sf1: Maybe if you mix it or shake it, or…
   T: Yes, well, but this wouldn't be diffusion, this would be external energy, ah, energy supply, so that's not the-, only diffusion then. Yes, but this was an idea. Ah, [Sf2]?
   Sf2: Maybe if you heat up the water?
   T: Yes! If you heat up the water.

In this manner, co-realised explorations are triggered by a teacher's question and ended by the teacher uttering a positive evaluation of the student's exploration. Note that evaluations occurring in this context do not represent the CDF EVALUATE. As describe in previous chapters, to be classified an evaluation in the terms of Dalton-Puffer's construct, an evaluating utterance has to be justified. This is definitely is not the case when uttering a simple *Yes*! or *Wonderful*! as a reaction to an exploration.

Further account has to be taken of the fact that not every student-teacher dialogue initiated by a teacher's question functions as an exploration. Certain properties that indicate the possibility or potentiality of the utterance are needed. Dialogues consisting of simple revision questions triggering answers which were discussed in former lessons cannot be understood as sequences of EXPLORE. Examples 86a-f present different aspects, classifying them as explorations.

Example 86.

a. T: In which part of the chloroplast would you find the enzymes for photosynthesis, [Sf]?
   Sf: **In the thylakoid membrane?**
   T: Yes in the thylakoid membrane.
b. T: Because you are you only need half of the information***...***Why?
   Sm: **Because you get the other half?**
   T: Where does it get the other half from? Do you have an-
   Sm: **From the partner?**
   T: Exactly!
c. T: Ah**, what would you do** in active transport? Or what would I do in active transport?
   Sf: Ah, give someone something.
   T: No, not with giving. How about [Sf]?
   Sf: Maybe if you walk somewhere, but if you…
   T: Yes, is this passive or active?

Sf: Active.
T: Active transport

d. T: How long **do you think will** this water level rise? Uhm [Sf]!
Sf: uhm, until the concentration of salt and water is equal?
T: Yes, is equal but will this really happen?

e. T: And **what do you think**?
Sm: Ich glaub de waren purple.
T: You say they were purple. So basically they weren't, okay?

f. T: **what does this remind you of?** [Sm] ?
Sm: The bilayer membrane.
T: Yes, it's a bilayer membrane, yeah. But when you see this, ah, membrane protein with these attached filaments**, does this remind you of something?**
Sm: Octopus?
T: No no no no no (laugh). No I think **something we discussed in cytology?** Ahm, yes, ah,[Sf].
Sf: Ah, bones that connect –
T: Yeah, I think she has an idea. Again.
Sf: Ah, bones that…
T: Oh where bones connect, you think, in…in a joint? No, that's not what I meant (laughs). Ah, if these are two cells…cell one and this is cell two; which other roles – ?
Sm: Asoo, junctions.
T: Yeah, junctions.

First of all, each of the six examples again shows the three-step-structure mentioned before. Example 86f illustrates that teachers sometimes even additionally motivate students to explore further, after verifying their answer. Moreover, the presented mini-dialogues display three different aspects, either found in teachers' questions or students' answers, indicating their exploring nature. First, students use certain grammatical structures which indicate that their statements are only a potential truth. The utterance of an exploration **in the form of a question**, like presented by examples 86a and b, was found to be rather common regarding the observed set of data and signals that students are guessing or predicting, without knowing the actual answer. Concerning the other examples, especially the teacher's way of asking questions indicates that an exploration is asked for. While in example 86c the teacher's use of the conditional in *what would you do* definitely classifies the subsequent sequence as an exploration, in examples 86d and e the teacher's question for what students think will be the outcome of certain processes is the determining phrase. All three examples nicely illustrate how teachers can motivate students to participate in explorations, by asking them to **share their thoughts on potential outcomes.** In example 86f, a phrase articulated by the teacher reveals that an exploration is uttered. In this case, the teacher motivates students to **draw on prior knowledge** to provide a potential answer. Through asking *what does it remind you of?,* and stating that they have already discussed this issue, the teacher actively encourages the student to hypothesise and draw conclusions. Although a co-constructed exploration by teacher and student might sometimes be hard to tell from simple revising sequences, there are definitely certain features that classify an utterance as potential.

Student

In contrast to Dalton-Puffer (2007) and Kröss (2014), who both reported a lack of S-realised instances of EXPLORE regarding their analysed data, 10 explorations realised by students can be reported on, as part of this study. Similar to students' contribution to co-realised instances of EXPLORE, explorations uttered by students individually without any influence of the teacher, are almost always realised in the form of questions. In this manner, students indicate that their utterance is a guess or maybe a hypothesis based on previously learned facts, but that it is definitely not based on hard evidence. They explore, and while formulating the exploration as a question, ask for validation by the teacher. This typical explorative behaviour is illustrated by examples 87a-c.

Example 87.

a. Sf: With the high concentration of salt does it mean that the water molecules are attracted to the salt molecules? And the water level rises on the left side?
b. Sf: I got a question, ah; do all the, for example the blood cells, have a similar, have similar carbohydrate chains?
c. Sm: Actually when you carry these two alleles, is there a twenty-five percent chance that they have an albino?

In each of these examples, students utter an assumption concerning certain topics like potential outcomes, chances or morphological similarities. Although they do not express their hypotheses by using grammatical structures that indicate modality, the communicative intention of their utterances still conforms to Dalton Puffer's (2013: 234) suggested communicative intention of this CDF, "I tell you something that is potential".

Teacher

As already mentioned, teacher-realised explorations are a rarely encountered phenomenon regarding this study. Nonetheless, the few instances found show, opposed to student- and co-realised utterances, clear indication towards the utterance of potential truths including phrases like *I think*, *I have to guess* or *I suppose* as illustrated by examples 88a and b.

Example 88.

a. T: And what can you observe? **I think** this is quite quick the, the tea, it's quite quick.
b. T: **I have to guess** now, it's because also we are somehow chemical controlled of pheromones, okay uhm so **I suppose** that this also plays a role.

Although both teachers seemed to avoid explorations and rather concentrated on discussing solid facts, their occasional utterances of EXPLORE are clearly denoted by phrases indicating a notion of potentiality.

As discussed with TS-realised explorations, a teacher's foremost role regarding EXPLORE seems to be encouraging students to predict and hypothesise rather than realising this CDF themselves.

8.6.2. Linguistic realisation

Dalton-Puffer (2007: 160) mentions EXPLORE to be interesting in terms of language use, since elaborate grammatical structures have to be applied for their realisation. Furthermore, she ascribed the lack of explorations, found in the data investigated by her, to its linguistically demanding character. Although explorations expressed by words of modality are also seldom found in the current data, EXPLORE is nevertheless among the three most frequently uttered

CDFs. Participants of the observed lessons were indeed prone to using elaborate grammatical structures, but they appeared to have generated methods of uttering explorations in a less elaborate form.

Especially students, when co-realising this CDF with teachers, tend to utter very simple explorations and in some cases, like presented by example 89a, they only consist of one word.

Example 89.

a. T: what kind of laws do I have to uhm predict how the offspring is going to be like? And what they have done is the following, they have taken, I don't know, taken let's see a grey dog and a brown dog and they crossed them and what did they get? What they got is a grey dog and a brown dog, a dog with brown spots, a dog with grey spots
Sm: Stripes.

Although, as pointed out by Dalton-Puffer (2007: 160) hypothesising prompts the use of modal verbs, adverbs, conditional conjunctions and certain lexical phrases, only a limited amount of these grammatical structures were encountered when observing the eight Biology lessons. In most cases either context, or as already mentioned several times, an implementation in the form of questions, classified utterances as explorations. In some special cases even a rising intonation would indicate that a statement is only concerned with potential issues. However, some examples found in the data are indeed characterized by a more elaborate language use, and representatives of each of the groups of grammatical structures typical for explorations, except for lexical phrases, were observed. While modal verbs are the most frequently applied grammatical structures in this context, represented by the words *might, could, will, would* and *should*, only two different adverbs occurred in the whole set of data related to EXPLORE, namely *maybe* and *probably*. Each of the following examples 90a-c represents one of the three observed groups.

Example 90.

a. T: Why **would** you have to drink, or why **should** you drink, why do they recommend drinking isotonic, uh yes [Sm] do you have an idea?
Sm: uh because of the minerals and if you switzen (laughing)

T: If you sweat, yes.
(MODAL VERBS)

b. T: In which, ah, situations, ah, yes, Lukas?
Sm: **Maybe** when you're ill, {T: Yes?} the body can see which cells are bacteria good or not?
T: Yes, that's true.
(ADVERB)

c. Sf: Ahm, I wanted to ask if you make colder ??? would less ???, **so if** you'd freeze the crystals in water, **would** they spread as well, or just not?
T: No, I think if the water's really frozen {Sm: Ganz leicht…}, then, yes, it depends on the temperature, I think, but then would move less.
(CONDITIONAL CONJUNCTION)

A further linguistic phenomenon, related to explorations and reported by Dalton-Puffer (2007: 160-161) are verbs and phrases introducing this CDF. Since introductory phrases like *we assume, I suppose* and *I have to guess* could be found in our material, this analysis could only but confirm Dalton-Puffer's observation. Especially phrases built on the word *think* like *What do you think?* or *I think* were commonly used to announce or initiate an exploration. Not surprisingly, these types of phrases seem to rather be part of the teachers language repertoire, since no student ever introduced an exploration in any of the lessons.

Concluding on the language use of explorations present in the current data, one can say that certain structures from the field of modality, as suggested by Dalton-Puffer (2007), are commonly used to express explorations. Nevertheless, realisers analysed in the course of this study, rather showed the tendency to avoid these complex structures. However, contrary to former findings (e.g. Dalton-Puffer 2007, Kröss 2014), participants uttered this function frequently, since instead of avoiding EXPLORE completely, especially students manage to work around the application of more complex structures.

8.6.3. Episodes

One further important feature of EXPLORE is that it appears to be among those CDFs, which can be realised in longer episodes including several other CDF types. In contrast to episodes of REPORT, which are usually realised by a teacher, episodes of EXPLORE are more commonly co-realised by teacher and students. Furthermore, they in general seem to include fewer other functions then episodes of REPORT. As example 91a and b illustrate, while uttering an extended exploration, most commonly classifications and explanations are included.

Example 91.

a. T: So, what about Huntington's disease? Yes.
   Sm: **Not sex-linked. (CLASSIFY)**
   T: Not – ; how do you know that?
   Sm: **Ahm, because there are both males and females involved. (EXPLAIN)**
   T: Yes and dominant or recessive?
   Sm: **Dominant. (CLASSIFY)**
   T: Why?
   Sm: **Because it's in every {generation} (EXPLAIN)**
   T: {It's in every generation} and not only that but – ?
   Sm: It's a lot of people.
   T: Lot of people and it does not, ahm, it does not jump generations, okay?
   Sm: M-hm.
b. Sf1: Maybe if you walk somewhere, but if you…
   T: Yes, is this passive or active?
   Sf1: **Active. (CLASSIFY)**
   T: Active transport.
   Sf1: Could you go there, and then, in passive maybe if you like go by train…?
   T: Yes, **if you ride a train or if you ride a car, then it's passive transport (CLASSIFY) because you only have to sit and then you're transported somewhere, yes. (EXPLAIN)**
   Sf2: **Also if you breathe then it's passive. (CLASSIFY)**
   T: if you?
   Sf2: If you breathe.
   T: If you breathe?
   Sf2: Yeah. And the intake of air…
   T: Okay, yeah

The rather frequent participation of CLASSIFY in these exploring episodes might have two different reasons. First, as can be inferred from both, example 91a and b, when triggering explorations, teachers often ask students to guess or hypothesise about classes of certain objects or processes. This results in classifications often being uttered with EXPLORE as an additional function. Alternatively, in some cases teachers ask students to CLASSIFY a term emerging in the course of an exploration or classify it themselves, which also causes CLASSIFY to appear in an exploring episode.

EXPLAIN is also a very commonly found participant of EXPLORE episodes and further has an important role in this context. Short explanations, mostly expressing causality, serve as justifications for certain explorations. In example 91a by asking *How do you know that?* and *Why?*, the teacher explicitly asks for explanations for the explorations, realised by the student, causing the latter to justify his utterances immediately.

Episodes, which are characterized by the appearance of DESCRIBE were also uttered in the course of the eight lessons. However, their use was almost totally restricted to situations in which the outcomes of experiments were explored, like illustrated by example 92.

Example 92.

> T: So what happens? Uh 'name'!
> Sf: Uhm so the water gets in the funnel
> T: Yes so water molecules will travel in through the semi-permeable membrane into the funnel. So water molecules travel or pass through through. And this makes as more water molecules travel into this sugar solution, what happens? Can we see something changing?
> Sf: Yes uh, water in the beaker gets lower
> T: Yes, okay so this will get lower, let's say it was at this, at this level so this will lower, will get lower, the water level sinks. And?
> Sf: And the water level in the funnel rises.
> T: Will rise, wonderful, yes. So here we said this was about this, so how it rises and let's say it is about here. Here the solution in column rises.

This whole TS-realised episode of EXPLORE is concerned with the several steps of a hypothetical experiment that are expected to happen, and can thus be classified as a process description too. Note has to be taken of the fact that science experiments seem to generally trigger longer episodes of EXPLORE. The correlation of experimenting and exploring in science education has already been mentioned by Kröss (2014: 31), who proposed that there is a need of EXPLORE when observing and analysing science experiments. Unfortunately, the number of experiments conducted as part of the eight observed lessons was limited, which also leaves us with limited data on this issue. Nonetheless, we assume that a closer look at the correlation of experiments in science education and the CDF EXPLORE might bring forth interesting results.

8.7. REPORT (Hofmann)

8.7.1. Types of reports

What has already been outlined in the theoretical chapter about REPORT is the distinction between three types of reports, namely *Research-*, *Discourse-* and *Cognition Acts*. The last of the three has never been identified in the corpus, and is therefore not included in the figure below. The large remainder of occurrences was coded 'unspecified' and will be analysed alongside the other two types.

Figure 35. *Discourse-, research-* and *unspecified reports* across lessons A1 – B4

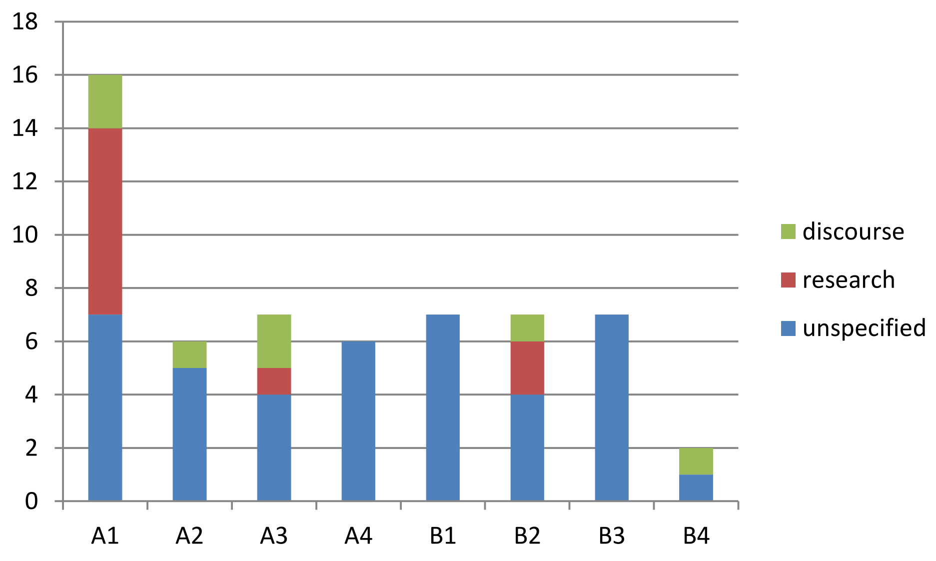


Figure 35 visualises the occurrences of the three types of REPORT in each of the eight lessons. Quite evidently the category of reports being neither discourse nor research reports is in all lessons the largest and contains 42 members, which is roughly three quarters of the entire number of occurrences. The total number of research reports amounts to 10 instances, and there are 7 discourse reports all in all. Another feature that becomes visible in the figure is the fairly even distribution of unspecified reports across all lessons, deviating only marginally from the average of 5 instances. The same cannot be said for research reports, which appear only in three lessons, A1, A3, and B2, the vast majority in the first of the three. Also discourse reports are not represented in all lessons; A4, B1, and B3 lacking instances entirely. The mean of all three reports put in one basket lies at 7 REPORT-instances per lesson, a number which is greatly surmounted in lesson A1 with 16 realisations; otherwise, however, this mean is in fact observed in four other lessons. The lesson with the least number of incidents is B4 with no more than 3 realisations.

Having said that, a fact which is not to be underestimated in our analysis is the considerable variation in length of reports. While other CDF types have demonstrated to be ranging only minimally in length, such as explanations, or classifications, REPORT is evidently the case where such differences turn out to be most prominent. In this sense, what is not perceivable in the figure above, but needs to be added to the quantitative distribution of reports in the corpus, is that the incidents of T1 are in average far longer than those reports coded in T2's lessons.

Research Acts

The first of the three categories under closer inspection are *Research Acts*; that is, all reports which convey a message about someone's scientific findings and include one or more reporting verbs connected to observation and research. This kind of report was encountered surprisingly often in our corpus, holding a total number of 10 occurrences. What is striking at closer observation is that in all of them, with one single exception, the realiser made use of the reporting verb *discover*, among a few others. *Discover* appears to hold a particularly popular position within its basket of research verbs, just like *because* is by far the most common causal conjunction. There are a few other notable characteristics which are featured in some exemplary instances below.

Example 93. [all T-realised]

a. and it was a British guy, ah, Robert Brown, who **discovered** in the eighteenth century, when he was looking under a light microscope. He was looking at pollen grains, ah, on a drop of water. And he **noticed** that they were moving all the time in any directions, so randomly, they were always bumping into each other. And **he made a protocol**, and in the protocol the movement of these particles **looked something like this** [shows on blackboard]. They were moving randomly.
b. they **discovered**, that actually his statistics of Gregor Mendel are too nice, he counted, he counted the flowers and he **kept the data in his lab-notebook** and they discovered ??? that his ratio of actually counted the flowers are too perfect
c. a night and he [Mendel] was lying in bed and wondering how this is work and maybe **he had this intuitive, uhm, how shall I say, insight**, and said...well, the only way the system works is if the information is stored two times…ja, in a plant. And **he invented** now a system of actually making uhm a cross and **he decided the following**: he said, use a capital letter if the characteristic is dominant and use a lower case letter, if the characteristic is recessive, weaker.

By taking a closer look at the three examples 93a-c of Research Acts, one will notice that several characteristics are shared by at least two of the three instances, although they have been realised by two different teachers, and are therefore independent of one another. First of all, the common utilisation of *discover* in examples 93a-b, which has already been pointed out earlier; example 93c, meanwhile, is the only exception in the data; here the teacher replaces *discover* by *he had this intuitive [...] insight*. The other research verbs have been marked in bold and are *notice* in example 1a, and *invent* in example 93c.

A second feature which is shared by examples 93a and 93b is the explicit mention of the scientist's protocol, or lab-notebook, again highlighted in bold, which is normally used to note down any relevant insights, results of experiments, calculations, hypotheses, etc... It is evident that this tool for keeping track of one's thoughts and insights is one inherently related to the profession of scientists, and apparently also teachers find the instrument indispensable in their research report about the professional activities of scientists. The resulting effect on the students is a positive one: by adding simple details about a scientist's working methods and techniques, the teachers open up a path for the students' imagination to access the mechanisms behind scientific work, and not any scientific work, but one whose findings they experience hands-on in the classroom. Naturally, such reports always include a variety of characteristics usually found in stories, such as a protagonist, in this case the scientist, and an assortment of props, such as the lab book, pencils, glasses, test tubes, ect...Another interesting case can be observed in example 93c; the teacher imagines the context that eventually led to Mendel's 'intuitive insight' and retells it to the students in the form of a narration. At one point he quasi 'slips' into Mendel's mind and recounts in direct speech what Mendel could have been thinking at that point. The general effect of the teacher's method of report is a narrowed gap, or better said, a bridge, between the scientist's reality and the student's reality, and hence make the scientist and his or her insights tangible for the classroom context.

Finally, a last similarity that can be identified at close contemplation of the research reports in examples 93a and 93c is their final move: both reports relate their 'narrative' back to the immediate context of the lesson with a statement about the scientist's concrete finding or formulation of standards. In example 93a the teacher states that in Brown's lab book the movement of the particles he observed *looked something like this*. She then points at the blackboard and indicates her own drawing of the particle distribution. In a subsequent step she introduces the Brownian motion as the type of movement that characterises the random distribution of particles within a solution. Similarly, the teacher in example 93c says *and he decided the following* and continues in the imperative and states the rules for denotation of dominance and recessiveness in inheritance patterns. In a third step, after the report, the teacher introduces the writing system by means of a range of simple examples, which also the students are asked to help solve.

Discourse Acts

The second type of reports, *Discourse Acts*, occurred slightly less frequently in the corpus. What is more, their length is considerably shorter than in Research Reports, exceeding no more than a single or at the most two or three sentences. The contemplation of their form leads to the conclusion that in structure and purpose they differ greatly from realisation to realisation, contrary to the previous type, which has been shown to contain a series of common characteristics. The four examples 94a-d below have been selected to represent discourse reports in our data.

Example 94. [all T-realised]

a. ah, so **we talked** about cell-to-cell recognition {T: Yeah?}, ahm, and it's, for example when you get a tissue transplant, you're body recognises if it belongs to your body or not {T: M-hm.} by the carbohydrate chains.
b. so in the low concentration **you said** that there is a high concentration of water molecules and in the high concentration is a low concentration of water molecules.
c. and what **they say** now is that it is possible for you to determine the genotype of these people.
d. **he said** the following, he said the following, well actually there must be two factors present. And he now did the following, he now decided that uh we have a purple crossed with white that's the P...parental cross and the purple he now said the following. We have big 'P', big 'P' crossed with little 'p' little 'p'.

A first classification can be undertaken separating the first two from the second two examples. The realisations in 94a and 94b are cases where a person within the classroom, that is, either a teacher or a student, recounts what has been said previously by either the teacher or a student. In example 94a, for instance, a student has been selected for a revision at the beginning of the lesson and is asked to briefly retell the content of the last lesson. And in instance 94b it is not a student, but the teacher, who reformulates what a student has said. Both examples clearly serve a specific function, namely the one of summarisation. It is probable that such teachers' or students' summaries appear at some point within a lesson, as oral reviews are a common method to revise what has been learnt before, and reformulations made by teachers to rearrange into a clearer structure what has been verbalised by students is an equally likely phenomenon.

Turning to examples 94c and 94d, these are less 'clean' incidents of discourse reports: though both contain the word *say* or *said* and indeed recount what someone else has stated, all the same at a close inspection they do not seem to convey as precise a reporting message as the above two. In example 94c the teacher presents a well-known scientific fact like something recently discovered and approved by someone with expert knowledge in the field, although this is, strictly speaking, not the case. The realisation in 94d has been coded 'Discourse Act' because it fulfills the formal requirements, although it does not only convey somebody's statements but also presents the scientist's actions by making use of the verb *did*. What the scientist actually said is displayed again in direct speech, as if Mendel were talking to himself at the very moment. The use of direct speech to bring closer what someone else has said or thought seems to be a signature move of T1, who also uses direct speech to relay what he thinks the students are (probably) thinking at the moment in various instances.

Unspecified Acts

The large remainder of reports has been coded 'unspecified' in a first step, and will be searched for distinguishable characteristics for classification in this subsequent step. The total of unspecified reports in all eight lessons amounts to 41 occurrences, which makes up more than two thirds of REPORT-realisations. Due to the length of most extracts only a few will be given in full, while from the majority only their beginnings, being characteristic for the type of report they entail, will be listed.

Personal Report:

The first type that can be classified according to certain criteria are personal stories or anecdotes. The content of these reports is about a situation which the speaker has personally witnessed, or someone close to him or her, and which is recounted because it fits into the current context of the lesson. Personal anecdotes usually involve the use of a first person narration and, inherently linked to this, a subjective viewpoint. As such, they share significant stylistic elements of narrations as suggested by Dalton-Puffer (2015: 21). Nevertheless, such narrations may in our view be considered incidents of REPORT as long as they centre around a subject-related theme which is immediately relevant for the classroom, and does not include such a degree of subjectivity that might affect the accurateness of the scientific input. The example below is such an instance of personal anecdote, and at close inspection it comprises a variety of typical characteristics:

Example 95.

> T: ja **the story goes like this** uh we had uhm uhm **I heard of this I was not part of the whole story** but my, we had a dog uhm a female dog who was like kept in the house and **my father said** many many many years ago, okay actually it would be nice also for the distant family, they have also dogs, so he took the dog to a a dog breeder, and uh to get the dog inseminated. And then indeed after some time there were the baby dogs here and at birth **I think** two of them died uhm one of them never barked at all, dog that never barks...he was just hanging around, the guy, it was totally mute, he couldn't, he couldn't, he couldn't make sounds, okay? And **I think** the other one, the other dog that survived basically, yeah also was **a bit strange**. And uh **this was actually not fine**, because the whole thing costed, costed money and then ??? turned out that there was a kind of was **a little bit sloppy** and that actually the dog, the female dog, **our female dog turned out, was inseminated with the sperm of her own father.**

First of all, the report is narrated from a first person perspective and includes instances of subjectivity in the form of personal judgments, such as *a bit strange* and *a bit sloppy*. Such judgments are an indication that what is being reported is not factual information but indeed a recount of a personal experience. A similar indication is made by statements of uncertainty, in this case twice the phrase *I think*, which indicate that what is being said is, again, not factual, but extracted from the speakers memory, which may, after all, be subject to faultiness. Also the second phrase marked in bold aims at forestalling the subjective nature of the report; by stating that he, the teacher, only heard the story wasn't part of it personally, he signalises that the subsequent 'story' is subject to impreciseness.

The last bold marking is the key sentence that smoothly embeds the report in the context of the topic, Mendel genetics, and leads back to the theory that is being learnt in the classroom.

Case Report:

Case reports are another category that has been identified several times in the corpus. In our data these reports surfaced only in T1's lessons, a circumstance which is perhaps connected to the topic. Mendel genetic is much more closely interrelated with human biology than transport across membranes, a topic where a deliberate link to the human consciousness is usually not established. Having said this, Mendel genetics is a topic most prone to bring up the mention of cases in recent history as well as former times about singular incidents resulting from inheritance issues. Cases widely circulated through the media are likely to be mentioned by the teacher, as they are bound to capture students' attention and fascination for the theoretical background of such incidents. Case reports generally discuss incidents which have been examined by the law, but they may of course also be based on informal cases which the speaker has heard of from or has read about in other sources.

Example 96.

> T: so, **story number one**, ahm; a **German court trial** of a few years ago **which has been going on for quite some time** where basically, ahm; there was a couple; they married, had kids, and then later on they discovered that actually they were brothers and sisters. {SM: uargh!} Biological brothers and sisters. They didn't know that because they were separated at birth. [...] if I remember correctly, but essentially {SF: die Chance, dassd da genau den findst...} Ah, **this was a big; this was a court case**, and the German court ruled that basically they're not allowed to have children and they're not allowed to marry, because that's...not allowed. And indeed many of the children; they had several children; many of the children had certain genetic conditions. Ahm, the reason being, **the reason being that when you have inter-family marriage you simply increase the chance, ahm, you greatly increase the chance that you put two recessive alleles together.**

The content of the report in example 96 is comparable to the previous one, presenting a case where inter-family mating leads to genetic conditions in the next generation, with the difference that here the case is considerably more sever, involving people, not dogs. The seriousness of the case is highlighted by the teacher's repeated reference to court, the relevant passages again marked in bold. The fact that the court case was *big* and *has been going on for quite some time aims* at underlining the urgency of this and comparable incidents. In a next step the teacher retells the content of the case, that is, the preceding event and the judicial consequences. The last sentence, once again, connects the outlined case with the theory of genetics that is subject of the lesson. Other decisive phrases that have been extracted from case reports in the corpus are the following:

now I heard somewhere, correct me if I'm wrong
another interesting case which emerged in the media now a few months ago
story number one, if I remember correctly
that's something that I read somewhere.

The underlying message conveyed in most phrases announcing case reports thus contains three types of information: 1) it is about a case which the speaker has read or heard about, 2) the case may have been involved in juridical matters, 3) the speaker cannot guarantee absolute precision of the stated information.

Summary Report:

Summarising reports pose a classification difficulty, as there are two slots which can be allocated to them: if they involve stating what has previously been said (about a certain topic, issue, etc…) then they would meet the formal criteria of a Discourse Act, such as example 94a-b under the section about Discourse Acts. If, however, the simple statement on a meta-level 'this is what has been said' is left out and the speaker proceeds directly to the summary of the content, then strictly speaking these instances would require a different category. Bearing in mind the priority position that simplicity in a classifying system should maintain, it is perhaps more convenient to assign all instances of summarising to its own category, disregarding any Discourse Acts.

It has been found that summaries can appear in quite a range of versions within our corpus data. The first two have been discussed in the section on Discourse

Acts, namely a student's summary in the course of a lesson-initial revision and a teacher's reformulation of a student's utterance. Another possibility is a summary of the previous lesson made by the teacher to evoke helpful images in the students' minds and to verbalise something which serves as starting point for new input. Characteristic beginnings of summaries that appeared in our corpus were the following:

to summarise a little bit
last time we started to talk about
So, we had
we learned about

The summaries that follow these initial phrases are usually performed by only one person, but combined TS-realisations do exist as well, as in example 97.

Example 97.

> T: **can you describe the experim**ent?
> Sf: okay, so **at first** we **put** $KMNO_4$ in it. That's potassium-permanganate, ahm the crystals, they **sank** down.
> T: you **put** it in water, m-hm.
> Sf: yeah. So, ah over time they **diffused**, and –
> T: are they –, yeah, but **what could we observe**? Yes, you could observe that they started to dissolve and at the end of the lesson?
> Sf: tt **was** just a little bit purple on the bottom and it wasn't like it was just on the bottom, but it was up in the middle, so, and then went farther and farther up.
> T: yes, and when I ??? in yesterday, what did we –, what **did** I observe? Yes, that it **was** already? Purple {Sf: pink…} throughout…, yes, but?
> Sf: in the top-most layer it **was**, wasn't as coloured as…
> T: it **was** a lighter purple {Sf: Yeah.} on top as on the bottom. Okay, **but now I'd say the solution**…
> Sf: it's pretty –
> T: pink throughout. Okay, thank you. The same with the tea bag.

The above example is an instance of a TS-realised summary of an experiment that was carried out the lesson before. What is being reported on is another cognitive discourse function, namely a physical as well as a process description. The initial trigger is set by the teacher, who requests a student to describe the experiment. The student then reports the process of the experiment in past simple tense, states each of the steps in the experiment and describes the physical qualities of the solution. In the end the teacher relates the report back to their present situation, stating how, in comparison to the lesson before, the solution looks like at the very moment, which serves again as the link between report and immediate context of the lesson, which has been pointed out in previous instances.

Introduction Report:

Another sub-type of reports are introductions, which serve as starting points for a new topic or sub-topic and usually provide a kind of theoretical background information which is aimed at inaugurating the learners in a controlled and guided manner into the new area of expertise. This category of reports has been identified four times in the corpus and the instances were initiated by the following phrases:

let's move on to
I would like to move on a little bit
the topic uh for this third of the year core is genetics
now we come to the new stuff

Example 98.

> T: **I would like to move on a little bit**. Ahm, I would like to...because there are more word problems **I'm going to give you next time** and **you need to know this information** in order to answer this [...] So, we now have the following situation in that...there are certain inheritable conditions. You're not allowed to say diseases sometimes, because sometimes, ahm, because it is not always politically correct. Now, there are a few conditions that **I'm going to talk about**, and one of these conditions is the condition called albinism. **You know what an albino –?**

The introduction report in example 98 above is initiated by the teacher's verbalised intention to proceed to another thematic unit. In a subsequent step he states his reason for introducing another set of theoretical information, arguing that the students would be needing it in the following lesson. The teacher therefore does not merely provide input, but rather addresses the use of the input to the students on a meta-level by referring to future lessons and activities. In yet a further step he gives an evaluation of the term *disease*, which is followed by his selection of albinism as the first of the inheritable conditions that he is going to broach in the lesson. In the last sentence, as usual, he refers the content of his report back into the context of the classroom by asking the students whether they are familiar with the genetic condition of albinism.

Input Report:

The last type of report is one that aims at feeding the students relevant subject-related information. In its intention it is therefore quite similar to an Introduction Report, with the only difference that its appearance is not in the beginning of a new topic or sub-topic. Much more typically it is situated right at the centre of a topic and its need presents itself spontaneously, that is, in an unforeseen manner by the speaker. In this sense, while Introduction Reports are usually pre-planned by the speaker, the need of Input Reports occurs unannounced and based on a concrete teaching situation. Such a situation might be a student's question for further or more detailed information, or a comprehension problem, or a missing bit of information that the teacher has detected, etc…At closer inspection of these kinds of situations which lead to the verbalisation of an Input Report, a resemblance to explanation type 1 becomes apparent. Bearing in mind the theoretical distinction between the three types of explanations and the fact that the first type was deliberately excluded of the EXPLAIN category due to its extensive nature, it does indeed seem that an adequate categorisation for this type of explanation has finally been discovered. The description of explanation type 1, 'to make sth. plain or intelligible; to clear of obscurity or difficulty; to give details of or to unfold (a matter)', conveniently matches the communicative intention of an Input Report, which aims at explaining a subject-related theme in the most general sense.

Example 99.

> T: when bacteria enter the body for example, or viruses, yes, ah, the **immune cells of the body, the white blood cells, recognise** whether they belong to the body or not. Sometimes, in auto-immune diseases or disorders, ah, what happens there? There's something wrong with the immune systems…So, **they think** that own body cells, ah, don't belong so **they start to fight them**.

The most notable feature of Input Reports is that the role of the grammatical subject is normally assumed not by persons but by biological agents, such as the white blood cells in the above example. Apart from this feature they do not possess formal criteria: due to their spontaneous and un-planned appearance they are not in any way announced by decisive introductory phrases, nor do they have to articulate a relation back to the immediate context of the lesson, as they are inherently linked to it by what information they provide, anyway. In conclusion, what characterises Input Reports is firstly their lack of formal criteria, and secondly the nature of the input, which is purely subject-related and does therefore usually make reference neither to the speaker himself/herself, nor to the listeners or a third party.

What follows is a table which summarises all the outlined types of REPORT and states their function as well as a list of common but not indispensable characteristics and formal criteria.

Table 31. Types of *reports*

Type of report	Function	Common characteristics
Research report	to tell about what a third person has researched	use of research verbs reference to a person's actions mention of a protocol or lab-book
Discourse report	to tell about what a third person has said	use of discourse verbs reference to a person's statements
Personal report	to tell about what oneself or an acquaintance has experienced and what has immediate thematic relevance for the lesson (otherwise: narration)	use of the first person singular indications of subjectivity use of informal style use of direct speech
Case report	to tell about what a third person has experienced and what may have received public attention	reference to the source of the information reference to juridical consequences
Summary report	to tell about the essence of what has been previously said or learned	use of the first person plural use of subject-specific terminology access of subject-specific knowledge may be realised by one or more persons
Introduction report	to tell about necessary information for what will be said or learned in the near future	use of the future tense use of subject-specific terminology access of subject-specific knowledge reference to a planned sequence of input

Input Report	to tell about purely subject-related information which spontaneously proves necessary for the immediate context of the lesson	use of subject-related agents as grammatical subjects use of subject-specific terminology access of subject-specific knowledge

8.7.2. Realisers

The distribution of realisers across the cognitive discourse function REPORT is similar to other types, with tendencies being perhaps even more drastic: the main realiser was the teacher, accounting for 52 of the 57 instances of reports. TS- realisations were encountered 3 times in T2's lessons, and students-authored utterances amounted to no more than 2 instances. Our explanation for the lack of student involvement in the formulation of reports is the density and interrelation with other CDF types. What is more, REPORT instances usually centre around longer strings of scientific knowledge, a circumstance which needs certain professional background for realisation.

8.8. Meta-talk (Hopf)

Although several instances of meta-talk occur in our corpus of eight observed lessons, this number is by no means comparable to the amount of CDFs uttered. As already mentioned in previous chapters, a limited number of occurrences of meta-talk under similar conditions was reported by Dalton-Puffer (2007) and Lackner (2012) based on their studies of CLIL classroom discourse. Nevertheless, at least according to literature reviewed before, meta-talk might potentially play an important role when teaching and practising the proper use of CDFs, which is why we decided to take a close look at different examples of this special phenomenon of classroom discourse.

Direct and implicit meta-talk

In general terms, meta-talk can simply be defined as talk, which is concerned with the rules or features of talk. Although this definition is characterised by its simplicity, sequences of meta-talk can be highly implicit and not as straightforward as their definition might suggest. Analysing meta-talk about a certain subject, like in our case CDFs, one instantly realises that at times the meaning of meta-talk might be detected easily, like in example 100a, while the meaning of meta-talk comparable to example 100b demands a lot of inferring work.

Example 100.

a. T: Definition; you know, definitions must be exact
b. T: what kind of laws do I have to uhm predict how the offspring is going to be like?

While in example 100a the teacher simply states that definitions have to be exact, example 100b is of a more complex nature. Here the teacher implicitly mentions, that predictions which are members of the CDF EXPLORE, are based on certain prior knowledge, in this case special laws.

Meta talk making reference and drawing on structure and form

Besides, this possible rating of an utterance of meta-talk on a scale ranging from being very clear to very implicit, all observable instances of this language feature might also be classified into two groups, according to qualitative factors of their realisation. While most instances of meta-talk only mentioned the performed CDF, other utterances were found, which aimed towards describing either the function or form of a certain CDF. While examples 101a-e illustrate the first type of observed meta-talk, examples 102a-c are supposed to exemplify the second type described.

Example 101. [all T-realised]

a. Which I'm going to **explain**.
b. I have to **guess** now
c. okay and let's let's let's uh **investigate** flower colour.
d. Yes but could you **explain** it in English, maybe?
e. You can use c, yes but you have to **define** it.

In each of these examples the teacher refers to a certain CDF type, in some more directly (101a, d and e), in others in a rather implicit manner (101b and c), but none of these utterances goes into more depth in terms of structure or form. Instead of informing students about actual linguistic aspects concerning CDFs, the purpose of these types of meta-talk is to either announce or to trigger the implementation of a certain CDF. In examples 101a-c the teacher classifies his own upcoming utterance as an instance of EXPLAIN and EXPLORE by announcing what to expect. In examples 101d and e on the other hand, the teacher uses meta-talk to tell students what he expects them to utter, which is in this case an explanation and a definition. Thus, already single words, making reference to a certain CDF, might give students ideas of different CDFs or influence their utterances.

The second and more structure- and form-related type of meta-talk, as presented by the following examples, is, a rather rarely found phenomenon with only 5 utterances of this kind observed in all eight lessons.

Examples 102.

a. T: Definition; you know, **definitions** must be exact.
b. Sm: Is it possible… that it would come out part of a different species?
   T: Nope. Then it would not be uh it would not follow the **definition** of a species.
c. T: And then basically looked at, they all said well actually it's the same type of dog breed, but actually I don't see any **system**. You see what I mean?

All three presented examples make reference to either specific structural or functional issues concerning different CDFs. While example 102a clearly states that definitions need to be exact, which addresses a formal issue of this CDF, examples 102b and c only hint towards functional issues. Although meta-talk here again operates on highly implicit level, both examples state why the definition and the classification would not be appropriate in each case. What cannot be overlooked is that an active and appropriate discussion of features, typical for certain CDFs, might not have been the teachers' intention with all presented instances of meta-talk. In all eight lessons meta-talk rather seemed to occur randomly and never in a planned manner, causing it to only seldom be helpful or explanatory in respect of students' CDF use.

P*re-emptive and reactive meta-talk*

Another distinction which can be made when different CDFs are analysed is based on their order of occurrence. As Basturkmen et al. (2010:11) point out, meta-talk either occurs before or after the utterance it is concerned with, creating two categories of meta-talk, which they call *pre-emptive* and *reactive* (Basturkmen et al. 2010: 11). They further report pre-emptive meta-talk to be a more frequent feature of classroom discourse, which became also apparent during the analysis of the material for this study. While only 8 instances of meta-talk could be classified *reactive*, the remaining 31 instances occurred before the actual CDF and hence form the *pre-emptive* group of meta-talk. The following set of examples presents both of these varieties.

Example 103. [all T-realised]

a. I'm going to uhm explain you the uh the experiment that he did.
b. Can you describe this experiment?
c. well this is correct; it is…strictly speaking, uhm, not the cleanest definition.
d. So we can say that your notebooks are homologous, this is my analogy that I'm using.

Interestingly, parallels might be drawn between this and the former distinctions, since pre-emptive meta-talk, as illustrated by examples 103a and b, appears to often have this announcing character mentioned before. Reactive meta-talk, on the other hand, is used to talk about the already uttered statement, sometimes in the form of feedback like in example 103c. This type of meta-talk is further prone to analyse structure and form of an uttered CDF in retrospective. Indeed, every utterance commenting on structural or formal issues found in the analysed set of data can be classified as reactive meta-talk. However, structure- and form-related meta-talk occurring pre-emptive to a CDF is of course possible and might be observable in a larger set of data, providing more instances maybe even from different teachers.

Meta-talk in written material

As mentioned before, pupils of Teacher 1 have the opportunity of receiving an international degree in Biology in the course of their IB programme. For this reason the school book, *Biology for the IB diploma: Standard and Higher Level* is provided that concentrates on the final exam for this degree. Although the teacher did not use the book during the observed lessons, a look at it revealed that knowledge about the implementation of certain CDFs appears to be pivotal for passing the exam. On one page at the very end of the book, titled "Guidance for students preparing for final exam", formal issues of questions and proper answers are discussed, and it is stated that certain keywords found in questions hint towards what kind of information students are supposed to provide in their answer (Allott 2001: 176). Some of these keywords and provided descriptions correspond with certain CDFs, discussed in the course of this study. EXPLAIN and EVALUATE for instance are mentioned in the following two statements and in some points definitely match Dalton-Puffer's (2013) concept.

> Explain – Sometimes this involves giving the mechanism behind something – often a logical chain of events, each one causing the next. This is a 'how' sort of explanation. A key word is often 'therefore'. Sometimes it involves giving the reason or causes for something. This is a 'why' sort of explanation. A key word is often 'because'
>
> Evaluate – This usually involves assessing the value, importance or effects of something. You might have to assess how useful a technique is or how useful a model is in helping to explain something. […] Whatever it is you are evaluating, you will probably have to use your judgement in composing your answer. (Allott 2001: 176)

Other CDFs are mentioned too, but titled differently, like "suggest" which might be recognised to be EXPLORE or "distinguish", which features aspects typical for CLASSIFY. However, these descriptions found in a school book illustrate that meta-talk is not restricted to actual talk and might also be realised in written form. The purpose of these accurate descriptions concerned with formal and structural issues of different discourse functions obviously aims to clarify how students are supposed to express ideas in different situations.

Unfortunately, precise meta-talk concerned with the structure and linguistic implementation of discourse functions was, in comparison to the numbers of uttered CDFs, a less common phenomenon of the observed classroom talk. This probably roots in the fact that CDFs, as well as meta-talk do not seem to be concepts students and even teachers apply consciously. We feel that a first necessary step is to raise awareness for these characteristics of classroom talk. Based on literature reviewed on, we came to the conclusion that under such circumstances meta-talk of high quality and clarity like presented in the observed school book, might help students to enhance their knowledge of appropriate discourse functions in certain contexts and might even help them to apply them by using more complex and sophisticated language. Especially the quality of CDFs like EXPLORE, which demand the use of more complex language, could profit from purposeful meta-talk.

9. Conclusion

A concise conclusion of our main findings should highlight the most foregrounding aspects of this thesis and will in this respect provide answers to our research questions. Addressing once more the central foci of analysis, it will portray a summary of quantitative findings, realisers and the most insightful facets of individual cognitive discourse functions in terms of characteristics, types and influences.

9.1. Discussion of quantitative findings (Hopf)

Considering the overall frequency of occurrence of different CDFs, clear tendencies were observable. While, under the analysed circumstances, DESCRIBE and DEFINE were the most frequently implemented CDFs, only a small share of utterances can be assigned to CLASSIFY, REPORT and EVALUATE. In respect of the fact that biology lessons formed the context of our analysis, this distribution does not come unexpected. Especially descriptions and definitions are crucial to science education mostly focusing on the discussion of fact-based content, whereas evaluations might be rather associated with subjects from the field of humanities. Note has to be taken of the varying distributions of CDFs when compared across different lessons or teachers. Although DESCRIBE and EVALUATE stand out if overall numbers are compared, these tendencies do not hold true when individual lessons are considered, which indicates that factors like topic, activities, methods, and individual students and teachers highly influence the frequency of certain CDFs.

As introduced during the course of this thesis, the realisation of certain CDFs in the form of longer episodes was observed. Although each episode included several individual CDFs, an overall function could be assigned to them. Particularly episodes of REPORT and EXPLORE were found to account for a high amount of these structures. In this case we came to the conclusion that the extended length of REPORT and EXPLORE compared to other CDFs might probably cause them being realised as episodes more regularly.

The last factor analysed quantitatively was meta-talk concerned with different CDFs, of which our investigation unfortunately only brought forth a small number of instances in comparison to observed numbers of CDFs. Nevertheless, certain types of meta-talk could be detected and especially the theoretical potential of meta-talk in the context of language learning as highlighted by Hu (2011) or Basturkmen et al. (2010), who were discussed in section 5.8., should be taken account of. In conclusion, the results of our own investigation and relevant issues elaborated by consulted literature, leaves us pointing out the possible benefit students might gain from being consciously enlightened about the use of CDFs via met-language. Particularly CDFs whose realisation requires more complex language structures could be taught and practised by applying proper and helpful meta-talk.

Interestingly, similar results, especially regarding most and least commonly occurring CDFs, were presented by Lackner's (2012) and Kröss' (2014) studies, which were also concerned with the discussion of discourse function in Austrian CLIL lessons. Even though the current study appears to reveal a much higher number of observed CDFs, conformities regarding certain tendencies become clear. Both studies also reported on a large amount of DESCRIBE found in their data and while Lackner (2012), who did not work with all CDFs, described CLASSIFY to be least frequently realised, Kröss (2014) detected only a few instances of EVALUATE. Hence, despite the fact that various factors might influence the frequency of CDFs in CLIL lessons, one might conclude that overall DESCRIBE appears to be very commonly used, while a lack of EVALUATE is noticeable, at least in science education.

9. 2. Discussion of realisers (Hofmann)

Considering the overall frequency of realisers T, TS and S, an unsurprising observation is the dominance of teacher-authored verbalisations. Throughout all eight lessons the teacher was by far the more active of the two realisers, students as a rule talking exclusively when directly addressed. In terms of the total of CDF utterances our data diverge significantly from Kröss' findings, which highlighted a prevailing TS pattern of realisation. The explanation for this discrepancy is close at hand: our study having dealt with smaller strings of realisations as proper CDFs, it is evident that these instances, which she only regarded as parts of larger CDFs, are less prone to be verbalised by both teacher and student(s), than just the teacher alone. A circumstance which has been emphasised various times throughout this study is the asymmetrical participation in TS utterances. As such, the realisation of CDFs in a TS-realised sequence is not undertaken by the teacher and students in equal measure, but much to the disfavor of students, who are rarely willing, or given the chance, to contribute significant inputs. From the perspective of single CDF types all but one share the same distribution of realisers, the most important being the teacher, followed by TS-realisations, and S-authored instances making the rear. Only EXPLORE was verbalised to a greater extent by a combined effort of teacher and one or more students.

A plausible reason for the dominance of teacher-talk and the absence of students-talk in our recorded CLIL lessons is the teacher's professional status, both in content- as well as in language-matters, a fact which seems to dissuade students from venturing own utterances, conscious of their status, which they themselves consider, after all, wholly unprofessional. It is perhaps this low-esteemed self-perception of students which would prove worthwhile to change, in order to create a learning environment more favourable for their exposure to and exploration of the foreign language.

9.3. Discussion of individual CDFs (as with CDFs in quant. and qual. analysis)

CLASSIFY

An extensive analysis of observed instances of CLASSIFY revealed that in particular the amount of *open* or *closed classifications* occurring, correlates with the topic taught in the lesson in question. Since this feature depends on the nature of the class itself, it is one of the few aspects which might not be influenced by either a teacher's or student's personal preference. Regardless of whether open or closed, most classifications were realised as *partial classifications*, meaning that a basis of classification is left out. This might most probably be caused by reasons of convenience, since less information has to be discussed when uttering this simple form of CLASSIFY. Another interesting aspect about this CDF is that apart from structuring and ordering, it might yield additional purposes. These suggested groups of purposes function in a clarifying, defining, exemplifying or dividing manner and are most probably extendable since our material is relatively limited and a larger set of data might put forth further sub-functions of CLASSIFY.

DEFINE

The CDF type DEFINE was found to be the second-most frequently realised cognitive discourse function. The analysis of their sub-types yielded a number of various characteristics and functions, which have been described in detail. *Language-related semi-formal definitions* were argued to be intimately linked to student's proficiency in the target language, and may therefore constitute a simple and valuable competence indicator in CLIL classrooms. Another dimension worth mentioning at this point are *translations* and their extensive set of different purposes, which again are strongly bound to language levels. The different levels of complexity inherent in definitions made known a correlation between the degree of difficulty of most often realised types and the prevailing language level in the classroom.

DESCRIBE

Based on our analysis, the CDF DESCRIBE proved to depend on topic, teaching methods and teacher. This dependency was in particular indicated by a fairly uneven distribution of descriptions across the two teaching sequences and the nature of different topics discussed. Further analysing the four description types *physical, structural, function* and *process descriptions*, physical descriptions turned out to be the dominant group, accounting for nearly half of all occurrences of DESCRIBE. Due to the extensive material of physical descriptions provided by the eight recorded lessons, several conclusions could be made regarding the realisation of this CDF sub-type. First, all utterances either approached information about conditions, spatial relations or components of different objects. Most of these instances were described in a general manner, since specified information is not always required and in some cases might cause difficulties in understanding. Furthermore, physical description could concern abstract concepts as well as actually observed objects, whereby a lower level of explicitness was encountered with the latter type, probably owing to the fact that all listeners are aware of the visual features described. Regarding realisers of DESCRIBE, high numbers of TS-realisations were observed, most probably resulting from an observable tendency of this CDF to appear in lesson revisions.

EVALUATE

Evaluations were the type of CDF that was by far the least often detected in the corpus. The considerable discrepancy between the two lesson quartettes points to a teacher- and topic-influenced type which is by no means taken for granted. What the similar objects of 'checking' evaluations indicated is that man-made systems are more prone to be checked, while products and processes trialled by nature tend to remain unevaluated. A distinction between mere judgments and 'real' EVALUATE instances proved necessary to highlight those, more complex-natured, instances which entail criterion-based justifications often taking the form of causal explanations. S-realisations were particularly scarce, students' non-professional status leading, most likely, to misconceptions about their own 'authority' to form, in particular, evaluative statements.

EXPLAIN

The results on explanations have demonstrated this CDF type to be largely independent of topic or teacher, verbalisations being comparable across lessons, both in frequency as well as in structure. One mentionable discrepancy between the two teacher's lessons, however, is the correlation between a high number of EVALUATE instances and causal explanations in the first lesson quartette. This overlap of two CDFs is an indication that types are indeed interrelated and may form an underlying network still largely undiscovered. Other CDF overlaps were identified together with DESCRIBE, EXPLORE and REPORT, all of which explanations form a part of in numerous instances. As such, realisations of the EXPLAIN type are, at least to a certain extent, dependent on other CDFs, which seem to uphold a function as a subject- or opinion-related grounding calling for the formulation of reasons.

EXPLORE

Since no suggested sub-types of EXPLORE were found in the relevant literature, different realisers provided the focus of analysis for this CDF. In contrast to all the other CDFs, EXPLORE was mostly TS-realised, commonly by a three-step process. Each co-realised explorations started with the teacher initiating a sequence of EXPLORE by asking a certain question, followed by the actual exploration uttered by a student. In further consequence, the teacher verifies or alters the student's utterance. Although previous studies (e.g. Dalton-Puffer 2007) predicted the use of rather complex grammatical structures for the realisation of EXPLORE, the data used for the current thesis revealed a different picture. Especially students tend to work their way around the use of complex grammar by formulating questions or a rising intonation at the end of their statements.

REPORT

Reports have been found to be more extensive in length than other CDFs, a criterion which renders them a greater challenge for students to verbalise. Their composition of other cognitive discourse functions alongside the handling of scientific knowledge are additional factors that restrain students from making reports. The qualitative analysis has given leave to the formulation of a range of REPORT types, which are due to their specific functions largely activity- and topic-dependent. Introductory phrases in many cases show a strong affinity to the type of reports they form part of and may therefore serve as an effective tool for identification purposes.

Our investigation shows that Dalton-Puffer's cognitive discourse functions are an inherent and substantial part of CLIL classroom communication, appearing both frequently and throughout a range of different contexts, such as experiments, revisions and discussions. After our observation and analysis of the various CDF types and their realisation, we come to the conclusion that Dalton-Puffer's proposition of cognitive discourse functions as the intersection of language and content does indeed have great potential. As such, we argue that they should be granted a central position in future CLIL research. Inside lessons, CDFs showed to offer a great opportunity for language work on syntactic, grammatical and lexical levels, embedded naturally in the context of the subject Biology. Particularly the investigation of CDF types, whose realisation demand more complex linguistic competences, revealed that the quality of students' communication of content knowledge could profit from a higher awareness of form and function. CDFs like EXPLORE, EXPLAIN and DEFINE tend to be realised imprecisely because the necessary language work which would lead to their proper and comprehensible implementation is missing. It is our view that this lack of language competence could be reduced through deliberately addressing and practicing CDFs in the classroom. This would require the inclusion of CDF issues in teachers' formation.

As discussed by Vollmer (2011: 6), language in general is of high relevance for science subjects like Biology, since teachers are supposed to educate their students to become responsible members of society that participate in decision-making processes often linked biological topics (e.g. environmental issues) and communicate their believes and arguments. However, when we consulted Austrian curricula for science education, we found out that although the importance of supporting student's language competences are mentioned, unfortunately, Austrian teachers are not provided with further suggestions or information about this issue.

Predictions about CDF occurrences made from the topic of the lessons showed that a profound expertise in both content and language may serve teachers to anticipate the kinds of language structures needed in the context of a particular subject matter. In this way, students can be prepared for the CDF types that will most likely be required in future lessons. The conscious utilisation of CDFs can thus be turned into a meaningful and targeted practice of CLIL lessons.

This study was designed to provide data for support of Dalton-Puffer's CDF construct and to give an insight into their application in Austrian CLIL Biology lessons. Our findings were based on a relatively small corpus of only eight such lessons, which calls for the need of further research and studies in the field of cognitive discourse functions to help refine our conclusions and feed more data into the CDF basin.

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Appendix A

Abstract

The CLIL approach has gained more and more ground in Austrian schools during the past few years due to its convenient dual-focused format. Said to be considering both content and language in equal shares, CLIL aims to integrate language-learning into subject-specific contexts and thus encourages the natural acquisition of a foreign language (Eurydice 2006). In practice, however, teachers tend to favour one of the two areas of expertise over the other, depending on their being either language- or content-teachers. Dalton-Puffer (2013, 2015) argues that a zone of convergence between the two pedagogies can be found in the field of cognitive discourse functions (CDFs). CDFs are verbalised cognitive processes which occur naturally when communicating content knowledge. As such, they are an inherent part of CLIL classroom discourse and are concerned both with language as well as content issues. Dalton-Puffer (2013) formulated a construct of CDFs in which she argues for the relevance of eight such cognitive discourse functions in the CLIL classroom. This thesis aims to support her arguments, giving a quantitative and qualitative analysis of CDFs in two Austrian upper-secondary CLIL Biology classes. Eight lessons were video-taped, recorded and by means of a computer program analysed. The main findings lead to the conclusion that CDFs are indeed regularly represented in the CLIL Biology classroom and that their successful realisation is linked to felicitous communication about biological issues. Apart from the eight CDFs (CLASSIFY, DESCRIBE, DEFINE, EVALUATE, EXPLAIN, EXPLORE, REPORT) also meta-talk about academic language functions was included in our study in order to investigate if discourse on a meta-level in this regard can prove beneficial for comprehensibility of cognitive processes. The study furthermore puts emphasis on the different realiser-types (teacher, student, teacher-and-student), revealing that the teacher is the main realiser, whereas students seldom verbalise CDFs, and if they do, it is usually in a more imprecise and less targeted manner. Therefore student participation and their utilisation of CDFs should be

encouraged in order to achieve more successful communication from their part. A further dimension that is considered in the study is the existence of sub-types of CDFs, as well as related criteria such as their particular contexts of use and their form and function. Our thesis shows that cognitive discourse functions are an integral part of CLIL classroom communication and are realised in a range of different contexts. We argue that teachers' and students' awareness of them may prove beneficial for content-specific classroom discourse in the foreign language.

Zusammenfassung

Im Laufe der letzten Jahre gewann das Unterrichtsprinzip CLIL mehr und mehr an Bedeutung, was wohl seinen zwei Schwerpunkten zuzuschreiben ist. Das Ziel von CLIL ist die Integration des Lernens von Sprachen in den Fachunterricht, um einen natürlichen Spracherwerb zu fördern, wobei Inhalt und Sprache in gleichen Maßen behandelt werden sollten (Eurydice 2006). Ein Blick auf die Praxis zeigt jedoch, dass meist eines der beiden Fachgebiete bevorzugt wird, je nachdem ob die Lehrperson Sprach- oder FachlehrerIn ist. Dalton-Puffer (2013, 2015) zu Folge stellen kognitive Diskursfunktionen (cognitive discourse functions, CDFs) einen Bereich dar, in welchem die Pädagogik beider Gegenstände aufeinander treffen. CDFs sind zum Ausdruck gebrachte kognitive Prozesse, welche natürlich durch die Vermittlung von Inhalten auftreten und als solche einen fixen Bestandteil der Kommunikation im CLIL-Unterricht darstellen. In einem von ihr formulierten Modell von acht kognitiven Diskursfunktionen, bespricht Dalton-Puffer (2013) die Relevanz dieser CDFs. Das Ziel dieser Diplomarbeit ist es ihre Vorstellungen und Argumente im Zuge einer quantitativen und qualitativen Analyse von CDFs im CLIL-Biologieunterricht der österreichischen Sekundarstufen II zu unterstützen. Zu diesem Zweck wurden acht Biologiestunden gefilmt, mit Tongeräten aufgenommen und mit Hilfe eines Computerprogramms analysiert. Die Ergebnisse der Untersuchung zeigen, dass CDFs tatsächlich regelmäßig im CLIL Biologieunterricht zu finden sind und dass die Einbindung dieser Funktionen eine erfolgreiche Kommunikation biologischer Themen ermöglichen kann. Um herauszufinden ob Diskurs auf Meta-Ebene die Verständlichkeit kognitiver Diskursfunktionen positiv beeinflussen kann, war neben den acht CDFs (CLASSIFY, DESCRIBE, DEFINE, EVALUATE, EXPLAIN, EXPLORE, REPORT) auch die Untersuchung von Meta-Sprache über Diskursfunktionen ein Teil unserer Studie. In einem weiteren Schritt wurden die Ausführenden Gruppen (LehrerIn, SchülerInnen, LehrerIn und SchülerInnen in Zusammenarbeit) der CDFs analysiert. Es zeigte sich, dass die Diskursfunktionen hauptsächlich von LehrerInnen ausgeführt werden, während CDFs bei SchülerInnen eher selten und falls doch, dann nur in unpräziser und wenig zielgerichteter Weise zum Einsatz kommen. Um erfolgreichere Kommunikation seitens der SchülerInnen

zu erreichen wäre es notwendig sie zur aktiven Teilnahme am Unterricht und Anwendung der CDFs zu ermutigen. Einen weiteren Aspekt der CDFs, welchen die Studie beleuchtet sind Untertypen der Funktionen, so wie ihr Einsatz in verschiedenen Kontexten, ihre Form und Funktion. Insgesamt zeigte unsere Studie, dass kognitive Diskursfunktionen ein wesentlicher Bestandteil der Unterhaltung und Wissensvermittlung im CLIL-Unterricht sind und dass sie in den verschiedensten Kontexten realisiert werden. Wir sind der Meinung, dass sich ein stärkeres Bewusstsein, sowohl auf Seiten der SchülerInnen als auch der LehrerInnen, bezüglich der CDFs förderlich auf den inhaltsbezogenen Unterrichtsdiskurs von Fremdsprachen auswirkt.

Appendix B

Curriculum Vitae

Angaben zur Person

Name: Jennifer Hopf

Geburtsdatum: 16. Jänner 1991

Geburtsort: Wien

Nationalität: Österreich

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Schulische Ausbildung

1997 – 2001: Volkschule, Natorpgasse 1, 1220 Wien

2001 – 2009: Realgymnasium, Bernoullistraße 3, 1220 Wien, Abschluss: Matura mit ausgezeichnetem Erfolg

Studium

2009 – 2015: Studium an der Universität Wien, Lehramt Englisch & Biologie

Sprachkenntnisse

Deutsch (Mutterspache), Englisch

Grundkenntnisse in Spanisch und Latein

Berufliche Erfahrung

Von September 2014 bis Jänner 2015: Kursleiterin für die Studienberechtigungsprüfung in Englisch an der VHS Floridsdorf

Seit September 2014: Kursleiterin für die Berufsreifeprüfung in Biologie an der VHS Floridsdorf