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"*If you get all tangled up, just tango on*."

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ABSTRACT

Triggered by the notion of globalization, the phenomenon of the spread of English as a Lingua Franca (ELF) enhances the use of English Medium Instruction (EMI) especially in tertiary contexts all around the world. The studies conducted on this ever-growing research field reveal that there are several pros and cons regarding the implementation of EMI in institutions. The implementation of EMI can be illuminated by observing and investigating actual classroom discourse of EMI settings. However, the existing body of research concerning EMI discourse is not all-inclusive, which creates a number of gaps in the field. Driven by this, the main aim of the current study is to investigate the use of cognitive discourse functions in Turkish tertiary EMI context. To this end, a corpus collected from 32 hours of non-participant classroom observation was compiled. The participants of this study are three EMI lecturers delivering content in various science disciplines at tertiary context. The transcribed data collected from their classes were coded in accordance with the cognitive discourse functions (CDF) construct offered by Dalton-Puffer (2013, 2016). As for the data analysis process of this qualitative study, a discourse analysis approach was adopted regarding the collected corpus. It was revealed that CDF were utilized by all participant lecturers reflected by the linguistic manifestations of their thought processes in the delivery of content. It was found out that the CDF "Define" and "Explain" were the most frequently employed types in the observed classes. Regarding the linguistic realization of those functions, common linguistic patterns each type of CDF were detected. Besides, the ways of achieving the key competences of the observed EMI lectures through the use of CDF was investigated and a number of occasions in which those functions were used to meet those competences were observed. Taken all together, this study emphasizes the importance of the use of CDF construct to promote the quality of EMI discourse.

Keywords: English-medium instruction, classroom discourse, cognitive discourse functions, tertiary context

ÖZET

Küreselleşme ile tetiklenen bir durum olan İngilizcenin ortak dil olarak yayılması fenomeni, İngilizcenin özellikle yükseköğretim seviyesinde öğretim dili olarak (EDİ) kullanılmasını artırmaktadır. Bu sürekli gelişen alanda yapılan çalışmalar İngilizcenin öğretim dili olarak uygulanması konusunda birtakım avantaj ve dezavantajlar olduğunu ortaya koymaktadır. Paydaşların destekleyici tutumları kadar, eğitim dili olarak İngilizcenin kullanıldığı sınıflardaki sınıfiçi söyleminin incelenmesini gerekli kılan birçok zorluk ve çatışma da rapor edilmektedir. Ancak, EDİ sınıflarındaki sınıf içi söylemi üzerine varolan literatür tam olarak kapsayıcı değildir. Bu durum bu alanda birçok boşluk yaratmaktadır. Buradan hareketle, bu çalışmanın temel amacı Türkiye'de yükseköğretim seviyesindeki EDİ sınıflarındaki bilişsel söylem fonksiyonlarının incelenmesidir. Bu amaçla, 32 saatlik katılımcı olmayan sınıf gözlemine dayanan bir derlem oluşturulmuştur. Bu çalışmanın katılımcıları farklı fen disiplinlerinde yükseköğretim seviyesinde eğitim veren üç EDİ öğretim elemanıdır. Onların sınıflarından toplanıp çevriyazıya dökülmüş veri Dalton-Puffer (2013, 2016) tarafından geliştirilen bilişsel söylem fonksiyonları listesine göre kodlanmıştır. Bu nitel çalışmanın veri analizi sürecinde söylem analizi yöntemiyle incelenen derlem, düşünsel süreçlerin dilsel yansımaları doğrultusunda, tüm katılımcı öğretim elemanlarının ders anlatırken bilişsel söylem fonksiyonlarını kullandıklarını ortaya koymuştur. Bilişsel söylem fonksiyonları arasında, "Tanımlama" ve "Açıklama" fonksiyonlarının en çok kullanılan türler olduğu anlaşılmıştır. Bilişsel söylem fonksiyonlarının dilsel tezahürlerine bakıldığında, her tür için yaygın dilsel desenler bulunmuştur. Bunun yanında, derslerin öğrenme kazanımlarının bilişsel söylem fonksiyonlarının kullanılması ile nasıl gerçekleştirildiği de incelenmiştir ve bu fonksiyonların öğrenme kazanımlarına ulaşmada kullanıldığı da saptanmıştır. Bu bilgiler ışığında, bu çalışma EDİ sınıflarındaki sınıfiçi söylemini geliştirmek hususunda bilişsel söylem fonksiyonlarının önemini ortaya koymaktadır.

Anahtar kelimeler: öğretim dili olarak İngilizce, sınıfiçi söylem, bilişsel söylem fonksiyonları, yükseköğretim

ABBREVIATIONS

AD: Academic discourse

ADF: Academic discourse functions

BICS: Basic Interpersonal Communicative Skills

CALP: Cognitive Academic Language Proficiency

CDFs : Cognitive discourse functions

CLIL: Content and Language Integrated Learning

CBI: Content-based Instruction

CL: Corpus Linguistics

DA: Discourse Analysis

DM: Discourse markers

EAP: English for Academic Purposes

ECTS: European Credit Transfer System

EDİ: Öğretim dili olarak İngilizce

EFL: English as a Foreign Language

ELF: English as a Lingua Franca

EMI: English Medium Instruction

FS: Formulaic sequences

HE: Higher education

MICASE: The Michigan Corpus of Academic Spoken English

MOI: Medium of Instruction

NATO: North Atlantic Treaty Organization

PYP: Preparatory Year Program

YÖK: The Council of Higher Education

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INTRODUCTION

The adoption of English as the global lingua franca brings the concept of English as the medium of instruction (EMI) into the forefront. Just like other countries embracing EMI, it is also being implemented especially in higher education (HE) in Turkey. Besides its benefits such as recruiting international students and staff, fostering institutional prestige, and enhancing career opportunities of students, implementation of EMI brings a number of concerns with itself as well. To be able to follow the lessons, students are supposed to have a certain level of competence in English. Instructors, on the other hand, need to be qualified enough to convey the content in English. More importantly, they need to smoothly convey what is happening in their minds while lecturing. Therefore, it is important for both teachers to deliver their cognitive intentions through linguistic manifestations and students to understand what they are supposed to do in response to them. Correspondingly, the current thesis aimed to reveal (i) the most frequent cognitive discourse functions (CDFs) employed in EMI lectures (ii) the lexicogrammatical structures to realize those CDFs, and (iii) the ways of achieving key competences by using the CDFs.

In the scope of the current study, EMI lessons delivered by three instructors working at two different state universities in Turkey were observed. 32 hours of lessons were recorded in total within a six-week period. As the method of observation, non-participant observation was preferred to collect authentic data without interrupting the natural flow of the lessons. The construct offered by (Dalton-Puffer, 2013: p.234; 2016: p.32) was utilized to explore the use of the CDFs in the observed lectures. After finding out the most occurring types of those functions, their realization by using linguistic structures is investigated. Finally, the ways of achieving the key competences of the observed lectures through CDFs are examined. The findings of the study demonstrated that CDFs are observable in EMI lectures, but not equally. The occurrence and preferred linguistic manifestations of CDFs differ depending on the content of the observed lecture Regardless of the subject of the lectures, the CDFs “Define” and “Explain” were far more frequent than the other types.

CHAPTER 1

1. INTRODUCTION

1.1. BACKGROUND TO THE STUDY

The concept of globalization has established close connections and linkages between states of the world (Gupta, 2015: p.4). It has been stated that globalization is consolidating the connections between national economies by dismissing barriers (Stiglitz, 2002: p.6). Globalization has also been defined as 'the widening, deepening and speeding up of world-wide interconnectedness in all aspects of contemporary social life' (Held, McGrew, Goldblatt & Perraton, 1999: p. 2). Correspondingly, a global interdependence has emerged in both social life and economy across countries. As a result of this global interdependence, English has been adopted as the international language by most part of the world, which is a phenomenon called English as a Lingua Franca (ELF). The main purpose of the concept of ELF is to facilitate communication among different nations in the world as the process of globalization accelerated. Because the number of non-native speakers of English outnumbers the native speakers, English has started to be the international lingua franca of academia (Mauranen, Hynninen&Ranta, 2010: p. 183). In this respect, English has become the medium of instruction in a number of educational institutions across the world. Within this context, the concept of English as a medium of instruction (EMI) has become prominent. EMI has been defined as "The use of English to teach academic subjects (other than English itself) in countries of jurisdictions where the first language of the majority of the population is not English" (Macaro, Curle, Pun, An & Dearden, 2018; p.15). Likewise, Zhao and Dixon (2017) define the term EMI as "the use of English for instructional purposes to convey academic subjects (e.g., finance, medicine or science) other than language itself" (p.1). This preference over English to deliver content courses is closely linked to the phenomenon of internalization (Knight, 2013: p.85). Similarly, it has been indicated that EMI and internalization have been so connected that this brings the concept of "Englishisation". (Kirkpatrick, 2011: p.29; Phillipson, 2010: p.90). With the overall internationalization of education, more and more educational institutions

have started to offer content courses taught in English. Particularly in higher education (HE) institutions, the number of both undergraduate and postgraduate courses offered in English has dramatically increased (Doiz, Lasagabaster& Sierra 2014: p.345; Earls, 2016: p.73) because this tendency has the potential to boost educational institutions' chance of attracting international students and faculty staff. With the increase in international students and staff, these institutions can keep up with the competitive educational market more easily and effectively by fostering their prestige level (Doiz, Lasagabaster& Sierra, 2013: p.1407; Li and Wu, 2018; p.29; Hu, 2019: p.2). Likewise, general student mobility has maximized the spread of EMI (Coleman, 2006: p.4). As for the triggering force behind the growth of EMI, the Bologna process was introduced and the number of countries that signed it has reached 49 so far including Turkey (British Council, 2015). Basically, a common framework for higher education among countries was the driving force of the Bologna process, which could foster student mobility and globalization (Macaro, 2018: p. 71). This common framework was achieved through a common credit system (i.e., European Credit Transfer System- ECTS), diploma and studying structure, which created homogeneity in the higher education systems of the signatory countries (Bologna Declaration, 1999). With the Bologna process, internationalization has been equal to English-medium instruction in HE for all the countries involved (Phillipson, 2009: p.37).

As for Turkey, with the introduction of the first Anatolian high school, the spread of English started its first phase in the 1950s and lasted approximately for two decades (Doğançay-Aktuna, 1998: p.28). In the 1980s, the spread of English gained a new dimension through the forces of globalization (Friedman, 1994: p.100). In 2001, Turkey's involvement in the Bologna Declaration (Ogul, 2012: p.107) brought homogeneity to higher education and increased mobility among students and staff, which accelerated the adoption of EMI in Turkey (Karakaş, 2016: p.2; Karakaş, 2018: p.788). The underlying reason why Turkey adopted EMI was the desire to compete on the international education market by attracting international students and raising income (O'Dowd, 2015: p.2). Besides, contributing to global academic literature to boost its higher educational institutions' rankings by enhancing their level of prestige was also aimed (Lehikoinen,2012; Rauhvargers,2013; Macaro,

Dearden & Akıncıoğlu, 2016: p.52; Hultgren, 2017; Kerestecioğlu and Bayyurt, 2018: p.8). Apart from the government's interest in EMI, students also aspire to enhance their career opportunities by immersing in English, which is the main reason why they choose to study at EMI programs. (Aslan, 2017: p.8). Correspondingly, the number of higher education institutions offering EMI programs has been increasing recently (Kırkgöz, 2005: p.218; Kırkgöz, 2007: p.102; Sert, 2008: p.157; Coşkun, 2013: p.1). Currently, some subjects like engineering or English are delivered through partial or full EMI in almost half of the Turkish higher education institutes (Arik & Arik, 2014: p.8). It is apparent that the place and importance of EMI is increasing day by day in Turkey, but there are also some concerns regarding the implementation of EMI. Dafouz and Smit (2020) point out that the implementation of EMI in HE is an exhausting process, and it needs a careful planification (p.30). Selvi (2014) notes that some institutions in Turkey take other well-known universities' language policies and make some changes on it in order to make it plausible (p.147). However, it is also argued that some higher education institutions need to change their current language policy before adopting a new one (Turhan and Kırkgöz, 2018: p.274). Therefore, it can be stated that the implementation of EMI is not 'one-size-fits-all' (Ozer, 2020: p.613), instead, a bunch of other methods, and needs and expectations of stakeholders should also be taken into consideration. In brief, because the concept of EMI is a newly introduced research area, there are still some gaps in this field that need to be filled.

1.2. STATEMENT OF THE PROBLEM

Globalization has totally changed the status of English from a national language to a lingua franca. Hence, the number of EMI programs offered in higher education (HE) institutions all over the world has a tendency to increase (Karakaş, 2018: p.789). With the establishment of Bilkent University in 1983, the first foundational university offering EMI education, and Middle East Technical University (METU) in 1956, the first state-owned university offering EMI education (Kırkgöz, 2007: p.219), the spread of EMI has also accelerated in Turkey as well. Needless to say, this increase is based on the benefits of EMI including gaining advantage in a globalized and competitive educational market with incoming

international students and staff (Soruç, Dinler and Griffiths, 2018: p.266). On the other hand, whether the quality of education could be maintained with the presence of this sharp increase has become a controversial issue (Arik and Arik, 2018: p.22). There have been some claims concerning the implementation of EMI in Turkey. Kırkgöz (2014) states that the learning process becomes more challenging through EMI from students' perspectives (p.446). The reason why EMI is seen as challenging for students is that students' level of comprehension is reduced through EMI if their level of proficiency in English is low. Curle, Yuksel, Soruç and Altay (2020) point out that students have a negative perception that their general proficiency of English affects their success in EMI especially when they are deprived of a constant academic language support (p.15). Such cases pose a difficulty for students to understand English language used by their instructor, so they cannot fully comprehend the content (Byun, Chu, Kim, Park, Kim and Jung, 2011: p.438). Çankaya (2017) suggests that students miss the details of content, spend extra time to catch up with the flow of lessons and have difficulty in grasping exam questions, which impedes their learning (p. 834). Accordingly, Macaro, Dearden and Akıncıoğlu (2016) assert that students think they need to make a remarkable effort to follow lessons conveyed through EMI (p. 9). Murata, Konakahara and Iino (2019) indicate that students seem more sensitive about language and, especially about speaking skill, instead of content (p. 185). The reason why students have concerns about speaking skill could be the lack of emphasis on speaking skill given in the preparatory year program (PYP) just before they start taking courses in EMI (Inan, Yuksel and Gurkan (2012). In addition to this concern, Sert (2008) also adds that even though students' theoretical knowledge of the content is advanced, they fall behind because of their lower level of English (p.167). In addition to students' problems, lecturers of EMI lessons also have some struggles. Ozer (2020) states that teachers believe that full EMI programmes limit students' level of comprehension particularly for technical courses (p. 622). While institutional motives focus on the promising sides of the implementation of EMI such as financial advantages, prestige, increased rankings helping to survive in the competitive educational market (Yeh, 2014: p.307), lecturers feel stuck in terms of conveying content knowledge because they feel pressured to work on their linguistic skills as well, which limits authentic interaction with students and makes the lesson atmosphere less engaging (Klaassen

and De Graaff, 2001: p. 282). Besides, lecturing in a foreign language is more demanding and requires more effort (Doiz, Lasagabaster& Sierra, 2011: p. 352). In addition to the way lecturers use the language, their teaching qualities are of significance in terms of a clear convey of content (Inbar-Lourie and Donitsa-Schmidt, 2019: p.10). However, some scholars claim that EMI lecturers do not follow a language-oriented teaching or ignore students' linguistic concerns because they think that they are not language but content teachers (Li, Zhang and May, 2016: p.8). Moreover, if their level of English is not sufficient to maintain an efficient EMI lesson, they may prefer not to allocate a particular time to modify their language with the fear of having a negative impact on their status (Tange, 2010: p.144). However, when instructors adapt their language or try to be more understandable by using different techniques, students can not only acquire the content but also the language simultaneously. Concerning the discourse elements to communicate more effectively, Sánchez-Garćia (2019) indicates that "strategic use of discourse" may contribute to delivering content smoothly in EMI classes (p.44). Besides, while doing this, it could also be helpful in terms of fostering students' language and content learning if they reflect upon their own discourse (Dafouz and Sánchez-Garćia, 2013: p.145). There have been a bunch of studies concerning general EMI discourse (Sinclair and Coulthard, 1975; DeCarrico and Nattinger, 1988; Morell, 2004; Hülmbauer, 2007; Kaur, 2012; Wu, 2013; Deroey, 2015; Wang, 2018; Sánchez-García, 2019; Shino, 2020, An and Macaro, 2021). However, the number of studies particularly focusing on cognitive discourse functions in EMI is not sufficient.

There are some ways for instructors to increase the effectiveness of the flow of their lessons. To reach some communicative goals like defining, explaining some terms or narrating a topic during lessons, instructors may benefit from cognitive discourse functions. Cognitive discourse functions (CDFs) are representations of subject-specific thought processes in the form of verbalizations (Dalton-Puffer, 2013; p.230). Cognitive discourse functions play an essential role in terms of integrating content and language (Doiz and Lasagabaster, 2021: p.59). Therefore, it is a field that is worth investigating. There have been some studies focusing on general discourse functions (Lemke, 1990; Bailey Bailey, Butler, Borrego, LaFramenta, and Ong, 2002; Dalton-Puffer, 2007;Smit, 2010; Evnitskaya, 2012; Lackner, 2012) and

cognitive discourse functions in CLIL and EFL settings (Kröss, 2014; Hormann and Hopf, 2015; Lechner, 2016; Brückl, 2016; Dalton-Puffer et al., 2018; Evnitskaya and Dalton-Puffer, 2020), but these studies do not focus on EMI classrooms. Hence, EMI classrooms have not been sufficiently explored in this regard, which is the triggering force behind this study.

1.3. THE PURPOSE OF THE STUDY

EMI is a rapidly growing concept that has been adopted by a remarkable number of higher education (HE) institutions in all parts of the world especially during the previous decade (Doiz, Lasagabaster and Sierra 2013: p.1407; Kirkpatrick, 2014: p.17; Earls 2016: p.73; Fenton-Smith, Humphries & Walkinshaw 2017: p.3). As for Turkey, adoption of EMI in higher education (HE) has also accelerated; therefore, a substantial increase in the number of higher education institutions offering EMI programs can be observed (Büyükkantarcıoğlu, 2004, p. 46). Turkish students tend to prefer EMI programs in the hope of better career opportunities (Nguyen, Walkinshaw & Pham, 2017: p.40). Moreover, it seems that they have an instrumental motivation to learn English like conducting graduate studies (Kılıçkaya, 2006: p.2; Kerestecioğlu and Bayyurt, 2018: p.20). Thus, the growing phenomenon of EMI in Turkey is also expanding.

As a research field, EMI has been called “A mushrooming phenomenon” (Soruç and Griffiths, 2017: p. 10), and therefore, there are still many parts to be explored. There have been some studies regarding the components of classroom discourse and discourse strategies in EMI settings (Tsui, 2014; Macaro, 2018; Smit, 2019; Sánchez-García, 2019; Harada & Moriya, 2020; Macaro 2021). However, as being one of the important elements of classroom discourse, cognitive discourse functions (CDFs) have not been studied in EMI settings. Most of the studies regarding CDFs are limited to CLIL and ELF contexts (Dalton-Puffer, 2007; Evnitskaya, 2012; Lackner, 2012; Kröss, 2014; Hofmann and Hoph, 2015; Brückl, 2016, Lechner, 2016; Dalton-Puffer and Bauer-Marschallinger, 2019). To this end,

cognitive discourse functions in EMI classes is an area which needs to be supported by novel studies.

Therefore, the current study aims to shed light on the use of cognitive discourse functions in EMI classes. In this respect, EMI lessons employed by three different instructors teaching at tertiary level in Turkey were observed. 32 hours of EMI lecturers were recorded, transcribed, coded and analyzed to have comprehensive and high-quality data.

Within the scope of this study, the frequencies and distribution of cognitive discourse functions have been focused by taking the construct offered by Dalton-Puffer (2013: p.234-235; 2016: p.32-33) as the reference. By looking at the frequencies, it has been aimed to find the distribution of various cognitive discourse functions used by the instructors in the observed EMI classes. It was revealed that there a range of different cognitive discourse functions was employed by participant instructors in EMI lectures.

As the next step, the lexicogrammatical choices to realize those functions were detected to clearly see how discourse participants' cognitive intentions are verbalized through the use of cognitive discourse functions in EMI context. It was observed that the very same cognitive discourse function could be manifested through various linguistic patterns.

Lastly, the key competences of the observed lectures were analyzed regarding how they were achieved through the use of cognitive discourse functions. It was found out that CDF play an important role to meet the requirements of those competences.

1.4. SIGNIFICANCE OF THE STUDY

There has been a growing body of literature concerning EMI over the last decade and the number of EMI studies has been increasing day by day. In this

respect, this thesis contributes to the existing body of EMI literature which still needs to be supported by novel studies as it is a relatively new research area. While studies concerning stakeholders' challenges, needs, attitudes, beliefs and perspectives (Doiz, Lasagabaster and Sierra, 2012; Başıbek, Dolmacı, Cengiz, Bür, Dilek and Kara., 2014; Werther, Denver, Jensen and Mees, 2014; Vu and Burns, 2014; Karakaş, 2015; Zhang, May and Ziang,2016; Cosgun and Hasırcı, 2017; Kahvecioğlu, 2019;Ekoç, 2020; Pun and Thomas, 2020) and strategies employed by students (Tsai and Tsou, 2014; Soruç and Griffiths , 2017; Soruç, Dinler and Griffiths, 2018) regarding EMI settings are more in number, classroom discourse in EMI classes has been explored in quite a few studies (Tsui, 2014; Macaro, 2018; Smit, 2019; Sánchez-García, 2019; Harada & Moriya, 2020). Accordingly, despite the fact that lecturers' use of discourse in EMI classes are one of the key factors determining lessons' productivity and students' comprehension, the shortage of discourse studies in EMI creates a need for further studies. However, there are not many studies focusing on actual EMI classroom discourse, especially the ones based on spoken discourse. Duran (2017) states that classroom interaction and discourse in EMI settings need to be investigated in detail to explore the field better (p.23). Correspondingly, the current study relies on spoken data so that it can shed light on the actual discourse of participating EMI classes better.

Among important components of classroom discourse, cognitive discourse functions are worth exploring. Dalton-Puffer (2013) states that while content teachers tend to solely focus on the subject, language teachers base their teaching particularly on language. Therefore, students studying content through a foreign or second language are deprived of the support required for the improvement of their academic language. At this point, Dalton-Puffer suggests that cognitive discourse functions (CDF) act as a "Zone of convergence" between language and content. Their active role in the construction of knowledge through repeated and identifiable linguistic patterns helps both lecturers and students (2013: p.216). For lecturers, conveying the content in appropriate ways is among the main objectives of lessons. For students, creating cognitive strategies to follow the lesson and comprehend the content are vital. Therefore, cognitive processes and language are interrelated (Dalton-Puffer, Bauer-Marschallinger, Bürckl-Mackey, Hofmann, Hopf, Kröss and Lechner, 2018:

p.9,). Thought processes taking place during lessons are realized through cognitive discourse functions with the employment of various linguistic patterns in academic lectures. By analyzing those functions, it is possible to find out the linguistic manifestations and representations of those thinking skills, which can be quite conducive to setting an efficient learning environment (Dalton-Puffer, 2007: p128-129; 2013: p.220). Furthermore, Kääntä (2021) suggests that the main purpose of the cognitive discourse functions is to gain a deeper insight about the ways subject-oriented cognitive actions reveal themselves in actual classroom discourse, which could also be named as mutual construction of knowledge both by teachers and students (p.4). By analyzing the use of cognitive discourse functions, the unobservable parts (i.e., *thought processes*) become visible and investigable. Therefore, cognitive discourse functions, especially the CDF construct offered by Dalton-Puffer (2013,2016), is of significance because it helps to understand how content and language are combined within classroom discourse, which is very crucial in contexts in which English is used as the medium of instruction (i.e., CLIL, CBI and EMI). Besides, it can contribute to empirical studies regarding those contexts since it can be used as a heuristic and measurable tool, which still needs to be tested (Dalton-Puffer, 2013: p.242, 2016: p.30; Dalton-Puffer et al. 2018, p.7)

In spite of the existence of some studies based on settings like CLIL and EFL (Lemke, 1990; Dalton-Puffer 2007; Smit, 2010; Evnitskaya, 2012), cognitive discourse functions studies conducted on EMI settings are thin on the ground. Hence, this research area needs to be explored through further studies.

Taken all together, this study is of significance because it not only focuses on cognitive discourse functions but also presents an actual picture of EMI classes thanks to the inclusion of spoken data collected from EMI classes in Turkish tertiary context. Besides, when taking into consideration the fact that there are not many studies examining the situation of Turkish tertiary EMI classes, this study is conducive to fill the gaps in the existing body of EMI literature in Turkey by providing an in-depth analysis of classroom discourse.

1.5. RESEARCH QUESTIONS

In the light of aforementioned background, the following research questions have arisen within the framework of this study.

1- Which cognitive discourse functions are mostly employed in Turkish EMI classes?
2- Which lexicogrammatical structures are used to represent cognitive discourse functions?
3- Are CDFs observable in the achievement of key competences of Turkish EMI courses?

1.6. OPERATIONAL DEFINITIONS

1.6.1. English-medium Instruction (EMI)

A recent working definition of English-medium instruction is "the use of the English language to teach non-linguistic academic subjects in countries or jurisdictions where the first language (L1) of the majority of the population is not English" (Macaro, Curle, Pun, An & Dearden, 2018; p.15)

1.6.2. English as a Lingua Franca (ELF)

English as a Lingua Franca (ELF) has been defined as 'a "contact language" between persons who share neither a common native tongue nor a common (national) culture and for whom English is the chosen foreign language of communication' (Firth, 1996: p.240)

1.6.3. Content-based Language Instruction (CBI)

Content-based Language Instruction (CBI) is an approach to language instruction that integrates the presentation of topic or tasks from subject matter classes (e.g., math, social studies) within the context of teaching a second or foreign language (Crandall and Tucker, 1990: p.187).

1.6.4. Content and Language Integrated Learning (CLIL)

Content and Language Integrated Learning (CLIL) is a generic umbrella term which would encompass any activity in which a foreign language is used as a tool in the learning of a non-language in which both language and the subject have a joint curricular role (Marsh, 2002: p.58)

1.6.5. Higher Education (HE)

HE (Higher Education): It is the post-secondary education provided by colleges or universities, which is also called *tertiary* education.

1.6.6. Academic discourse (AD)

Hyland (2009) defines the term academic discourse as “the ways of thinking and using language which exist in the academy” (p.1).

1.6.7. Language Functions

Fathman, Quinn, and Kessler (1992) indicate that “Language functions are specific uses of language for accomplishing certain purposes” (p. 12).

1.6.8. Academic language functions

Dalton-puffer (2007) states of communicative functions are met through certain linguistic structures, which are called academic language functions (p.128).

1.6.9. Cognitive discourse functions (CDFs)

Dalton-Puffer (2016) defines cognitive discourse functions as “verbal routines that have arisen in answer to recurring demands while dealing with curricular content, knowledge and abstract thought.” (p.29).

CHAPTER 2

2. REVIEW OF LITERATURE

2.1. INTRODUCTION

The aim of this chapter is to shed light on previous studies conducted on the areas of EMI and cognitive discourse functions. Initially, the spread of English as a lingua franca is analyzed. Then, the current teaching approaches through English and the phenomenon of EMI in Europe, Middle East, Asia and Turkey are presented based on relevant studies. Afterwards, the definition of academic discourse and related studies, some important terms in the field of academic discourse, cognitive discourse functions and related studies are reviewed. Lastly, as the target topic on this thesis, the issue of cognitive discourse functions and EMI is examined.

2.2. GLOBALIZATION AND ENGLISH AS A LINGUA FRANCA (ELF)

Globalization led to a considerable amount of increase in mobility around the world that also enhanced language contact. In this respect, English apparently differs from other languages and is regarded as the default global language, or lingua franca as a result of the concept of globalization (Mauranen, 2018: p.7). An early definition of English as a lingua franca (ELF) is a "contact language between persons who share neither a common native tongue nor a common (national) culture, and for whom English is the chosen foreign language of communication (Firth, 1996: p.240) While native speakers of English have been included in Firth's definition, House (1999) described ELF as "interactions between members of two or more different lingua cultures in English, for none of whom English is the mother tongue" (p.74). Another definition is "The term lingua franca is normally used to mean a contact language, that is, a vehicular language between speakers who do not share a first language." (Mauranen, 2018: p.7). Likewise, lingua franca has been explained as "a language of wider communication – that is, a language that is used for communication between groups who do not speak each other's languages" (Thomason, 2001: p. 269). With respect to its lingua franca status, English has

become an indispensable part of today's internationalized world (Widdowson, 2018: p.101). Moreover, Mauranen (2016) states English is the most widespread language in the world ever (p. 29). To shed light on the development of ELF, it is necessary to refer to historical events that reshaped the status of English as a global language.

The spread of English can be based on two main historical events which are the expansion of Britain as a result of the colonial period and the changing status of the US as a superpower in the world. The US is the third most populated country which also hosts most of the native speakers of English accordingly (Graddol, 1997: p.7). In addition to the expansion of Britain and the rise of the US, other factors contributing to the phenomenon of ELF should be taken into consideration as well. The era in which we live requires a huge need to communicate, disseminate and share knowledge, which fostered the spread of English more than other political or historical factors (Björkman, 2013: p.3). Ultimately, the dominance of English and the need to disseminate knowledge led to the emergence of the term ELF. Regarding the utilization of English across countries, Kachru (1985) made a classification regarding English speaking communities in terms of the acquisition patterns and functions of English, known as "three concentric circles of World Englishes (WE)" (p.12).

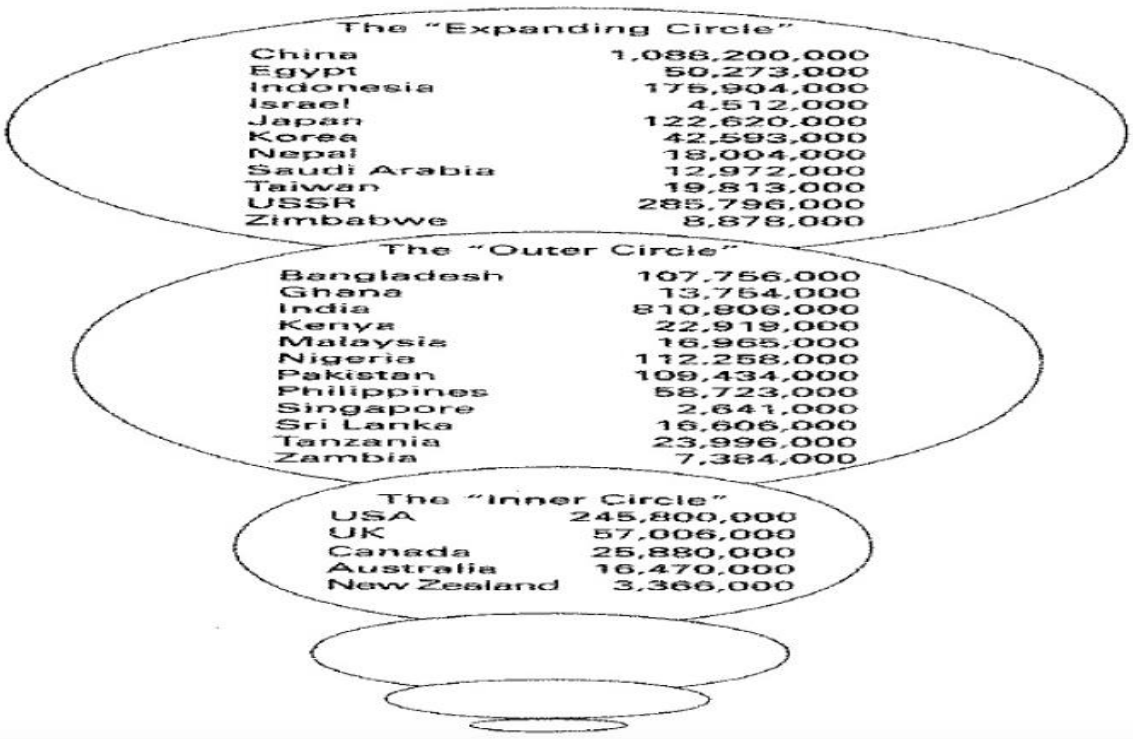

*Figure 1.*Kachru's three concentric circles of World Englishes (WE) (Kachru, 1992, p.356)

The inner circle includes countries in which English is utilized as a mother tongue (e.g., England, America). Besides, Kachru (1990) labels these countries as "norm providers" as the English spoken in those countries is accepted as accurate and taken as reference (p. 14)

The outer circle encompasses countries where English functions as a second or institutional language but not a mother tongue (e.g., Malaysia, Singapore, India, Ghana, Kenya). These countries are called "norm-developers" since they generally have their own variety of English (Kachru, 1990: p.16).

The expanding circle countries are the ones in which English is learned as a foreign language (e.g. (Turkey, China, Japan, Greece, Russia). These countries are "norm-dependent" because they aspire to reach inner circle countries' norms as their ultimate goal (Kachru, 1990: p.17).

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However, Kachru's World Englishes (WE) model and the concept of ELF differ because of the fact that borders among countries have been blurred as a result of globalization (Flowerdew, 2015: p.15). Nonetheless, this model is still given importance in terms of representing the general status of English across countries.

2.3. RECENT TEACHING APPROACHES THROUGH ENGLISH

The status of English in HE has started to gain a new dimension all around the world by gradually being the language of instruction. Recently, there have been various teaching approaches in which instruction is delivered through English such as content-based instruction (CBI) or content-based language teaching (CBLT), content and language integrated teaching (CLIL), and English-medium instruction (EMI). However, these terms may be used interchangeably referring to all kinds of teaching approaches in which content is conveyed through a second/foreign language (Dearden &Macaro, 2016: p.456; Marsh, 2008: p.236; Stoller, 2008: p.59). Indeed, these terms are actually different from each other both theoretical and practically.

Content-based instruction (CBI) or content-based language teaching (CBLT) is a teaching approach in which a foreign/second language is utilized for instructional purposes. CBI or CBLT has been defined as "an integrated approach to language instruction, drawing topics, text, and tasks from content or subject matter classes, but focusing on cognitive, academic language skills" (Crandall and Tucker, 1990: p. 83). Based on this, it is apparent that the main focus of CBI is language learning and content is just a tool for the acquisition of the target language (Brown and Bradford, 2017: p.331).

Content and language integrated teaching (CLIL) refers to the process of conveying curriculum through a foreign language in which learners have the chance to acquire the target language authentically (Coleman, 2006: p.4). Through CLIL, students can be exposed to content which is combined with language (Airey, 2016: p.71). That is to say, CLIL is a teaching approach in which both content and language are practiced simultaneously (Smit and Dafouz, 2012: p. 1). Besides, there

are four key compounds of CLIL playing a significant role in terms of the integration of content and language: Content, communication, cognition, and culture (Brown and Bradford, 207: p.330). Based on these points, it can be argued that language teaching occupies a considerable place in CLIL.

Another important term regarding English-based teaching approaches is English-medium instruction (EMI). Dearden and Macaro (2016) describe EMI as "an umbrella term for academic subjects taught through English, one making no direct reference to the aim of improving students' English" (p. 456). Regarding EMI, the main aim for students is to reach mastery in content, not language. (Unterberger and Wilhelmer, 2011: p. 96). There is no intention of fostering students' language improvement in EMI and acquisition of the language is incidental because language acts simply as a tool for transmission of content with no specific objective of language teaching (Brown & Bradford, 207: p.330)

Based on the brief background given to grapple with the differences between these three terms, each of them should be recognized as distinct concepts. In her study, Macgregor (2016) states that participant teachers assumed CBI and CLIL to be the same (p. 431). However, content is only a vehicle to teach language in CBI while content and language are equally important in CLIL. Regarding the difference between CLIL and EMI, there is always an explicit language component to support the content teaching in CLIL, whereas there is none in EMI (Dearden, 2014: p.4; Jenkins, 2018: p.7). Lastly, it can be argued that EMI and CBI are actually opposite terms. While focus is the content in the former one, it is language in the latter. To sum, In EMI, content is central; CLIL has an equal focus on content and language; and in CBI, content is the core part of teaching process (Brown and Bradford, 207: p.332). It is important for educators to distinguish between these terms in order to provide a better and efficient learning atmosphere for their students.

2.4. ENGLISH MEDIUM INSTRUCTION (EMI)

With the rise of globalization and the adoption of the Bologna process aiming at unifying European higher education (HE) and promoting "the competitiveness of the European Higher Education" at an international scale (Bologna Declaration, 1999: p.1), the growth of EMI has accelerated throughout the World (Björkman, 2016: p.58; Mauranen 2012: p.106, Murata and Iino, 2018: p.401, Smit, 2010: p.45). EMI is an "*elusive*" term because it may be both used as an umbrella term for other teaching approaches like content-based Instruction (CBI) or content and language integrated learning (CLIL), and it may also be used in substitution for those terms (Macaro, 2018: p.14). Hence, there is no consensus on a single definition because it is a recent research field; therefore, there are a bunch of definitions of EMI (Macaro, 2018: p.31). Nonetheless, the most prevalent and recent definition is "the use of the English language to teach academic subjects other than English itself in countries or jurisdictions where the first language of the majority of the population is not English" (Macaro, Curle, Pun, An, and Dearden, 2018: p. 35).

In the light of the aforementioned background of EMI, the role of "E" in EMI needs to be clarified. Just as there is not a single definition of EMI, there is also no consensus about what kind of English should be used in EMI classes. Macaro et al. (2018) touch upon this controversy:

> "… are we talking about a 'native speaker English' or other nativized varieties of English, or indeed of English as a lingua franca (ELF)? If it is ELF, then how does this affect international students from different geo-linguistic areas, including English-dominant ones? "(p.38)

However, Jenkins (2018) states that EMI lessons should be conveyed from an ELF perspective because EMI settings are actually ELF settings because of the presence of students from different ethnic and cultural backgrounds (p. 7). In this regard, there has been an increase in the number of ELF-oriented EMI studies (Smit, 2010; Mauranen, 2012; Björkman, 2013; Kalocsai, 2014; Jenkins, 2014; Hu, 2015; Ishikawa, 2016; Karakaş, 2016; Cavanagh, 2016; Galloway, Kriukow and Numajiri, 2017; Walkinshaw et al., 2017; Ra, 2018).

There are also concerns on the issue of EMI policies adopted by HE institutions. Walkinshaw et al. (2017) state that EMI policies are adopted uncritically by stakeholders for the sake of internalization and marketing purposes (p.7). However, the implementation of a such "one-size-fits-all" approach brings potential problems (Walkinshaw et al., 2017: p.16; Iino, 2018: p.98). Therefore, it should be noted that EMI needs to be implemented for students studying "*not English*, but *through English"* (Walkinshaw et al., 2017: p.16).

Another important dimension that should be highlighted is the fact that classroom practices or the way lecturers deliver the lesson may differ even though EMI programmes are assumed to be "English-only" (Costa and Coleman, 2012: p.14). Lecturers may shift between their native language (L1) and English or students may constantly use their mother tongue while interacting (Jenkins, 2018: p.7). In the study conducted by Ra (2018), it was found out that students were prone to use their L1 or their own variety of English in their ELF classes, instead of using a nativized version of English while communicating, which emphasizes the fact that classroom dynamics such as translanguaging should be taken into consideration (p. 219). However, there are insufficient numbers of studies focusing on actual classroom practices through an in-depth analysis of actual EMI classrooms or a rich amount of qualitative classroom data (Murata and Iino, 2018, p. 401). In brief, EMI discourse is a field that needs to be discovered more.

2.4.1. English Medium Instruction (EMI) in Europe

In Europe, internalization of higher education dates back to the late 1990s (Altbach and Knight 2007: p. 293) for the purpose of a "borderless European space" (Doiz, Lasagabaster, and Sierra 2011: p. 347). Therefore, EMI showed a substantial growth especially in European tertiary education followed by the Bologna Process in the late 1990s (European Higher Education Area and Bologna Process, 2016). With the changing status of English as lingua franca and the language of academia (Coleman, 2006: p. 6), EMI has been an indispensable part of European higher education (Bradford and Brown, 2017: p. 328). More and more higher education

institutions started to offer programmes taught fully or partly in a foreign language, almost always English' (Ritzen, 2004: p. 33).

In terms of higher education in Europe, there were only 725 English-taught programs (ETP) in Europe in 2001 (Wächter and Maiworm, 2002: p.27). The number of ETPs in Europe reached 2,389 in 2007 (Wächter and Maiworm, 2007: p.23). Ultimately, this number increased to 8.809 in 2014 (Wächter and Maiworm, 2014: p.36). Apparently, it can be stated that the number of ETPs or programs offering EMI education the number rose more than tenfold between 2001 and 2014 based on these studies (Bradford and Brown, 2017: p. 329). Regarding graduate programs in European higher education, EMI programs in European universities have grown exponentially (Hultgren, Jensen &Dimova, 2015: p.3) in master's courses (Coleman, 2006: p.6). The number of graduate ETPs was 560 in 2001. This number has steadily increased over the years and reached 3,701 in 2011 (Brenn-White and van Rest, 2012: p.7).

To draw a country-based picture of the spread of EMI in Europe, Coleman (2006) states that teaching through English has been being implemented in Netherlands and Sweden since the 1950s and in Finland, Hungary and Norway since the 1980s and this trend has expanded to Europe in general over the past three decades (Coleman, 2006: p. 6). In France, the need for EMI programs is now being recognized although the language policy of the country has been based on the maintenance of French for a long time (Coleman, 2006: p. 8). Among European countries, Germany is a "frontrunner" in terms of the total number of EMI programs (Gürtler and Kronewald, 2015: p.90) and various programs offering EMI have already been introduced (Meyer 2004: 76). Likewise, Finland is one of the countries where English is so frequently spoken that the country is now called "Little England" and it becomes an alternative for the students who miss the chance to attend an exchange program in the UK (Lehikoinen 2004: p.46). In Hungary, the ratio of students learning English increased from below 20% to over 50% as a result of globalization (Enyedi and Medgyes 1998: p.4). In Denmark, there is also the trend to compete with the global educational market which requires the use of English (Phillipson, 2003: p. 47). The same situation can also be observed in Baltic countries

with the increasing EMI programs in business schools especially in Latvia and Lithuania (Hogan-Brun and Ramonienė, 2004: p.70). In Croatia, the Bologna process and internalization enhanced the place of student/staff mobility and EMI in Crotatian universities (Margić and Vodopija-Krstanović, 2015: p.47). In Italy, EMI programmes increased in the late 1990s just like the other countries and especially in fields like economics and engineering for business purposes (Pulcini and Campagna, 2015: p. 72). In Iceland, English is also an inseparable part of both daily life and education (Ingvarsdóttir and Arnbjörnsdóttir, 2015: p.139). Overall, it can be stated that EMI is still a common and growing phenomenon across Europe.

2.4.2. English Medium Instruction (EMI) in Asia

To understand the development of EMI in Asia, it is important to touch upon the role of English in the region. English was the default language of Association of South-East Asian Nations (ASEAN) which is an organization to maintain a growth in social and regional dynamics. Followingly, the establishment of Asia-Pacific Economic Cooperation (APEC) to keep regional and economic stability in Asia and the inclusion of Asian countries like Cambodia, China, Laos, Taiwan and Vietnam in the World Trade Organisation (WTO) made English a continental necessity which paved the way for the increase in EMI programs in Asian universities (Walkinshaw et al., 2017: p:3). Thus, it can be stated that the development of EMI in Asia is somewhat similar to the process in Europe triggered by the process of globalization (Macaro et al., 2018: p.49). Asian universities' desire to compete in the global educational market by attracting foreign students depended on drawing themselves up as a "destination" for higher education (Walkinshaw et al., 2017: p:3). In one of the Asia Pacific Economic Cooperation (APEC) summits held in 2012, the issue of enhancing mobility of students and staff was discussed, and this "Bologna-like" plan subsequently accelerated the adoption of EMI in Asia (Kirkpatrick, 2014: p.18).

On a country-basis development of EMI in Asia, the launch of 'Top Global University Project' (TGU2016) aimed at the introduction of full/partial EMI programmes in Japan and it was reported that 227 out of 778 universities offered

EMI programs (Macaro et al., 2018: p:49). The ministry of education in Japan also indicated that the funding would be increased to expand the place of foreign staff and students along with lectures delivered through English (MEXT, 2014). Just like Japan, English has been given an important place in education in China and it is required by the ministry of education for the higher education institutions to deliver 5–10% of their undergraduate lectures in English which is a must for entrance evaluations of local universities (Lei and Hu, 2014: p.100). In Indonesia, the announcement of a bilingual curriculum (e.g., Bahasa Indonesian and English) was done in 2016 with the intention of fostering English fluency among students and staff so that English can be utilized in both communication and academic research (Dewi, 2017: p.246).

Even though over 95% of the population speaks Chinese as their native language in Hong Kong (Trent, 2017: p.220), it has an established EMI education continuing for decades with eight state universities offering full EMI education (Kirkpatrick, 2017: p.30) due to its being a previously British colonial country. In Malaysia, there are 40 private universities offering EMI education and The Philippines has also over 90 private universities which offer various courses in EMI (Kirkpatrick, 2014: p. 20-21). Between 2005 and 2010, the number of EMI classes offered in South Korean universities has been tripled (Kim, 2017: p.56). A similar trend was observed in Taiwan with 29 universities offering 92 various degree programs in EMI in 2013 (Macaro et al., 2018: p.49). On the other hand, even though it is the second most spoken language after Bangla, English is not utilized as the medium of instruction in Bangladesh which was previously colonized by Britain (Hamid and Jahan, 2015: p.85). In sum, aspiration for attracting international students made Asian universities more globalized and increased the necessity of enhancement in EMI programs (Walkinshaw et al., 2017: p.3)

2.4.3. English Medium Instruction (EMI) in the Middle East

The Middle East has also witnessed a substantial growth in the number of EMI programs in HE (Macaro et al., 2018: p.48). Even though English is not an official language in the Kingdom of Saudi Arabia (KSA), it is given a remarkable importance in terms of the country's internationalization and development in technology and science (Macaro, 2018: p.88). The Ministry of Education in KSA encouraged all universities in the country to adopt English as a medium of instruction (MOI). Consequently, students in KSA are supposed to attend a one-year preparatory program to survive in an EMI institution (Ryhan, 2014: p. 141).

In the United Arab Emirates (UAE), all state universities are required to offer the majority of the courses in English, which also necessities the introduction of a preparatory year program (Macaro, 2018: p.88-89). In Qatar, the place of EMI in HE is not that grounded when compared to KSA or UAE. However, Macaro (2018) states this issue has been grabbing attention from both education parties and media so the spread of EMI in Qatar may be eminent (p.90).

2.4.4. English Medium Instruction (EMI) in Turkey

To draw a general picture of the development of EMI in Turkey, it is important to review the inclusion of English into the language policy of the country. The inclusion of English into the language policy of Turkey dates to the Tanzimat Period. Tanzimat was a period lasting between 1839 and 1876 in which westernization gained speed in almost all aspects of life, including education. In the Tanzimat Period, Robert College, the first EMI institution in Turkey, was already founded (Kırkgöz, 2005: p.160). Followingly, closer connections with English-speaking nations were established with the proclamation of the Republic in 1923, which increased the importance of English in Turkish education system (Kırkgöz, 2007: p. 217).

In 1997, students began to take English lessons starting from the fourth grade as required by the educational reform called “Improving National Education Pro ject”. With the enactment of a new reform in 2012, compulsory education was extended to 12 years and English started to be delivered beginning from the second grade. (Kırkgöz, 2017; 240-247). Presently, second, third and fourth graders are given two hours of English lessons per week, while fifth, sixth, seventh and eighth graders have three hours of English weekly in primary and secondary Turkish state schools (MEB, 2018a). The hours of English lessons generally increase in private primary schools as English is introduced to students starting from grade one as an “extracurricular activity” (Selvi, 2014: p.135).

In 1955, the introduction of the first Anatolian high school brought a new dimension to English-medium instruction since students in these schools experienced a more intensive exposure to English than the ones in state high schools owing to the fact that Anatolian high schools were providing a preparatory year before the beginning of actual content classes all of which were also delivered through EMI. However, the implementation of such a system was hard because of the shortage of qualified teachers to deliver content courses in English (Kırkgöz, 2005: p.15). Ultimately, this trend was given up in 2006 (Selvi, 2014: p.137). Currently, the hours of English lessons differ among higher education institutions in Turkey depending on their being state-owned or private.

Because there was not a long-standing history regarding tertiary education in Ottoman Empire, the first modern universities in Turkey adopted a Western European style (Şimşek, 2007: p. 1004). This tendency changed as a result of the 1950 elections in which Democrat party came into power. After World War II, Turkey decided to strengthen the connections with America and the country was admitted to The North Atlantic Treaty Organization (NATO) in 1950, which reshaped the status of higher education. Accordingly, new universities were established under the influence of America, one of which was The Middle East Technical University (METU) (Şimşek, 2007: p.1005). METU was the first state university offering EMI education. Followingly, Boğaziçi University, whose foundations were laid in 1863 with the establishment of Robert College, was

officially founded in 1971 claiming to offer a 100% EMI education. The risen number of state EMI universities also motivated foundational institutions as well. Established in 1984, Bilkent University became the first foundational university offering various EMI degree programs (Selvi, 2014: p.138). In 1980s, the wave of globalization also penetrated Turkish educational system (Kırkgöz, 2007: p. 218). To survive in such a globally competitive environment, it became vital for students to learn English to find decent jobs and advance in their career (Ahmad, 1993: p.210). Subsequently, a number of other higher education institutions including Koç and Sabancı University also started to provide students with 100% EMI degree programs in the 1990s (O'Dwyer and Atlı, 2018: p. 295). With the legislation of Education Reform in 1997, private institutions were also entitled to offer EMI programs especially in tertiary context, and this raised the number of EMI degree programs (Saricoban, 2012: p. 2643). Nevertheless, students and staff mobility were not sufficient to call those institutions "international" until 2001 when the Bologna Process became more of an issue for Turkey.

In 2001, Turkey signed the Bologna Declaration, which marked a new period of EMI in Turkish tertiary education with the motivation to increase level of quality and internalization in Turkish tertiary education (British Council, 2015: p.43). Signing the Bologna Process, Turkey took an essential step in terms of promoting "international reputation" of Turkish higher education institutions and making them more appealing to international students (Westerheijden et al., 2010: p.94). That is why, the EMI institutions before the Bologna process are called "first generation" while the ones established after the process are called "the second generation" because the second-generation EMI institutions had a larger potential to attract international staff and students which increased mobility thanks to the Bologna Process. As for the second-generation EMI institutions in Turkey, there were 193 EMI institutions offering EMI programs in 2014 and currently, this number exceeded 200 even though the exact number of EMI institutions in Turkey is unknown (Bayyurt and Karakaş, 2016: p: 96-97) Besides, it is predicted that almost a quarter of newly established foundational universities are EMI institutions (Arik and Arik, 2014: p:8).

There are two distinct patterns regarding the implementation of EMI in Turkish tertiary context: Full and partial EMI. Both state and foundational universities have been administering a proficiency exam for incoming students to be admitted to EMI programs. As an alternative to universities' own proficiency exam, international language examinations (e.g., IELTS and TOEFL) or exams held by the Council of Higher Education (YÖK) and Turkish Republic Student Selection Centre (ÖSYM) may be accepted depending on the institution. Generally, students who cannot provide a valid score from an acceptable exam are obliged to attend a preparatory year program (PYP) (Selvi, 2014: p.138). The main purpose of the PYPs is to prepare students for the content courses to be delivered through English in the following year and they also act as a *"bridge"* between secondary education and higher EMI education (Macaro, Dearden &Akıncıoğlu, 2016: p:52). Once passing the proficiency exam or completing the preparatory year successfully, students commence their content courses delivered through full or partial EMI (Macaro, Dearden &Akıncıoğlu, 2016: p.3). In full EMI programs, all lectures in all departments in an institution are delivered through 100% English while this ratio is 30% in partial EMI in which only particular departmental courses are taught in English.

In addition to its significance in undergraduate EMI programs, English is also essential for academia in Turkish. In Turkey, researchers are supposed to publish in international journals especially in the ones listed in Social Science Citation Information (SSCI) to promote their academic recognizability, and this requires them to write and publish in English (Kırkgöz, 2007: p:219). Likewise, the instructors assigned to give lectures in EMI classes are needed to have a certain level of English proficiency. Therefore, both independent researchers and EMI lecturers need to certify their level of English proficiency in order to be permitted to publish in English. To this end, they are required to take central examinations approved by The Council of Higher Education (YÖK).

2.5. ACADEMIC DISCOURSE

2.5.1. Features of academic lectures

The spread of English as a global lingua franca has substantially affected education in almost all parts of the world. Accordingly, academic discourse has started to be seen as a unified register in language teaching and learning especially after the establishment of the courses for English for Academic Purposes (EAP) to meet the communicative demands of tertiary-level students in academic settings (Flowerdew, 2002: p 25). Therefore, academic lectures have become like "a cornerstone of many tertiary level courses and, due to the increase in student numbers, it is likely to remain so" (Exley and Dennick, 2009: p.10). In this regard, there have been a bunch of studies concerning the features of academic lectures in literature (Flowerdew, 1994: p.7). MacDonald, Badger and White (2000) state that academic lectures are oriented to a particular discipline, they are conveyed to audiences through specific ways, and they include distinctive rhetorical structures as opposed to other spoken contexts (p.256).

The way the interaction or the use of discursive devices may change depending on the content. Macaro (2019) states teacher talk, which is the core part of EMI discourse, may change according to the discipline (p.11). Discipline-based language use differences among academic lectures have been found in some studies (Dudley-Evans and Henderson, 1990; Ädel, 2008; Schleef, 2008; Kashila and Heng, 2014; Wang, 2017). Likewise, Thompson (1997) indicates that lecturers in language classes may prefer to pose more questions to the audience compared to science lecturers. Correspondingly, interruptions made by the audience have found to be less frequent when compared to language classes, which minimizes the level of in-class interaction (as cited in MacDonald et al., 2000: p.256).

Being another aspect of academic lecturers, the style employed by lecturers may differ as well. Lecturers may deliver the content by simply reading from a structured text named as *reading mode*, referring to their notes which is called *conversational mode*, or following a *rhetorical mode* supported by their own

performance of improvising (Dudley-Evans, 1994: p.148). As for the rhetorical mode, lecturers may follow a "point driven" or "information driven" approach depending on their preference or the topic (Olsen and Huckin, 1990: p.33). The point driven approach is mainly about problem solving whereas the other approach is based on mere delivery of content (MacDonald et al., 2000: p.256). These kinds of different use of language by lecturers result in different learning outcomes as well (Macaro, 2019: p.11).

Among essential parts of discourse features of academic lectures, the use of rhetorical markers, signaling devices, and discourse markers is important. (MacDonald et al., 2000: p.257; Martín del Pozo, 2016: p.28). Lehrer (1994) argues that the presence or absence of discourse markers in academic lectures is closely related to the level of student comprehension (p.62). Similarly, Flowerdew and Tauroza (1995) claim that the use of "lower-level discourse markers" such as *so, OK, well* contributes to students' understanding of lectures (p.449). Such phrases play a vital role in indicating the importance of a specific point in lessons (Martín del Pozo, 2016: p.28). The use of discourse markers is of significance in terms of signaling rhetorical organization of the discourse in academic lectures and it helps students follow the threads of information in lessons (Dunkel and Davis, 1995: p.59).

2.5.2. Previous studies on academic discourse

Hyland (2009) defines the term academic discourse as "the ways of thinking and using language which exist in the academy" (p.1). Research into academic discourse has substantially increased especially in recent decades owing to the emergence of three considerable phenomenon: i) the increase in the number of university students especially triggered by globalization, ii) the interest in teaching and learning as a result of competitive education market and iii) the transformation of English into a global academic lingua franca (Hyland, 2009: p.2-4). Accordingly, academic discourse has become a highly studied topic in literature.

Academic discourse is usually different from other kinds of discourse in terms of its syntactical, lexical, and other stylistic properties (Gafiyatova, Korovina,

Solnyshkina, and Yarmakeev, 2017: p.190). These properties are important components of the way lecturers use the language in academic lectures, which becomes a main concern among stakeholders of educational institutions because of its undeniable impact on controlling the flow of lectures and maximizing students' creating space for students to learn the content (Tsui, 2004: p.184). Hence, this particular field has been examined by various scholars from different dimensions.

Some discourse studies are based on the theoretical framework of sociocultural perspective. For instance, Cazden (1988) suggests the area of classroom discourse is like applied linguistics because the use of language affects both classroom activities and the construction of knowledge (p.3). There have been some other studies focusing on the role of discourse in students' comprehension from a sociocultural perspective (Cazden, 1988; Edwards & Mercer, 1987; Goodman & Goodman, 1994; Hall, 1998; Lee &Smagorinsky, 2000; Mercer, 1995; Moll, 1994; Tharp & Gallimore, 1988; Wells, 1999, 2000; Wells & Chang-Wells, 1992).

Particularly focusing on lecturers' use of language in academic discourse, formulaic sequences in academic lectures are also among the mostly studied topics in this area. Some studies conducted on the relationship between using formulaic sequences and students' level of comprehension (Flowerdew and Miller, 1997; Thompson, 2003; Nesi and Basturkmen, 2009; Neely and Cortes ,2009; Schnur, 2014; Deroey, 2015; Formentelli, 2017). Wang (2018) also conducted a study on lecturers' use of formulaic sequences (FS) in ELF academic lectures based on a disciplinary perspective and found out that the most dominant formulaic sequences are fixed two- or three-word phrases having no semantic function in addition to the presence of disciplinary differences between the usages of FSs (p.373). Apart from FSs, Núñez and Dafouz (2007) studied the general phases of academic lectures delivered by content teachers in CLIL lessons and found out that transitions between phases were not clear in discourse of those lectures (p. 41).

As an indispensable and mostly lecture-guided part of academic discourse, the "triadic dialogue" which is also called the Initiation- Response-Feedback (IRF) pattern has been examined by some scholars (Bellack, Kliebard, Hyman and Smith

,1966; Sinclair and Coulthard, 1975; Mehan, 1979; Edwards and Mercer, 1987; Cazden, 1988; Lemke, 1990; van Lier, 1996). The presence of this cycle, initiated by teachers (generally through a question), followed by students' response and feedback or evaluation of the teacher, has been obviously observed in all of these studies (Tang, 2017, p:3). In further research on IRF in academic discourse, ways of making classroom interactions more dialogic, constructivist, argumentative, and exploratory through IRF pattern have been studied (Mortimer and Scott, 2003; Mercer, Dawes, Wegerif, and Sams, 2004; Chin, 2007; Erduran, Simon and Osborne, 2004).

As for an exemplary classroom discourse study conducted in Turkish context, Ege (2020) investigated the discourse strategies used by lecturers in Turkish tertiary EMI classes. It was found out that discursive strategies including fillers, self-rephrasing, and code-switching occupied a huge place in lectures. The functions of those strategies were mainly about coping with linguistic problems and enhancing level of comprehension and communicative potential of students (p.134-135).

2.5.3. English for Academic Purposes (EAP)

Concerning academic discourse, English for academic purposes (EAP) is an essential term that needs to be discussed. Coined by Tim Johns in 1974, EAP is defined as the process of teaching English to learners to help them study or conduct research in that language" (e.g., Jordan, 1997: p. 1; Flowerdew and Peacock, 2001: p. 8). A recent definition of EAP is "an approach to language education based on identifying the specific language features, discourse practices, and communicative skills of target academic groups, and which recognizes the subject-matter needs and expertise of learners" (Hyland, 2018: p. 383–384). Moreover, students need to be competent at global and domain-specific terminologies, functions of language, and discourse structures to be called academically proficient in a language,
(Bailey and Butler 2003: p.8).

The growth of this important concept, EAP, can be associated with some important changes in the world. Firstly, the process of globalization has made EAP contexts more divergent. In addition to learning English as a foreign/second

language, people have also developed a tendency to learn English for academic publications and thesis and dissertation defenses (Humphrey, 2016: p.447; Feak, 2016: p. 489). This situation turned English into the main disseminator of academic knowledge which encouraged students, educators, researchers, and scholars to gain competency in English (Graddol, 1997: p.61; Hyland and Jiang, 2020: p.5).

EAP can be observed in many components of education including pre-tertiary, tertiary, and post-tertiary education, spoken interactions within classroom, written studies, academic research, and administrative implementations (Hyland, 2006: p.2). It involves a bunch of practices including designing materials for learners and preparing students to acquire academic literacy (Hyland and Jiang, 2020: p.4). However, there are some concerns regarding EAP lecturers. Administrative forces expect lecturers to deliver lessons in English, attend to English-speaking meetings, present at international conferences, and publish academic studies in English, but their capability to perform these duties has been an issue (Hyland, 2006: p.3).

The concept of EAP discourse is also controversial. Hutchinson and Waters (1987) argue that variations in the use of grammar and functions and structure of discourse are not sufficient to propose a subject specific EAP discourse (p.165). In this regard, EAP lecturers find it challenging to address the needs of students from a variety of disciplines such as engineering, medicine, and history because their choice of rhetorical devices while delivering lessons is supposed to differ depending on particular disciplines, which necessitates specific varieties of academic discourse in EAP. However, it is hard to find a "common core" of EAP lectures (Hyland, 2018: p.391-392).

2.6. DISCOURSE FUNCTIONS

2.6.1. Academic language functions

It may be challenging for students to comprehend lectures in English since they are supposed to engage in the "bottom-up" processing of incoming data and interpretation of creation of meaning by referring to their background knowledge,

which is a "top-down" process (Hyland, 2009: p.97). Furthermore, there are a number of factors having an impact on students' level of comprehension. In most traditional academic lectures where the lecturer is seen "'the main giver of information' (Furneaux et al., 1991: p. 80), students suffer from a bunch of challenges including catching up with the speed of delivery, attaining to unknown vocabulary items and pragmatic cues, having difficulty in grabbing the organization of academic discourse and following the transitions between ideas or steps of processes, (Flowerdew, 1994: p.12; Flowerdew and Miller, 1996: p.30; Thompson, 2003: p.19). Moreover, Flowerdew (2002) claims that it is hard to find a "common ground" for individual disciplines in academic lectures to combine distinct disciplinary subjects (p.28). Therefore, students are supposed to be familiar with different discourses for different disciplines.

The aforementioned problems can be solved with the improvement of some basic student skills which can be developed through lecturers' use of discourse functions. Discourse or language functions are certain usages of a language to achieve specific goals (Fathman, Quinn, and Kessler, 1992: p.12). That is, language use is shaped during lessons based on the purpose. Language use can function as describing, explaining, or persuading through the preference of particular language structures (Hill and Flynn, 2006: p.25). However, it is important for lecturers to know about language functions while shaping their discourse. When lecturers are aware of academic discourse functions and deliver the content in accordance with those functions, a more effective and productive learning environment can be maintained and students can be assisted better in terms of grasping content knowledge (Martín del Pozo, 2017: p.117).

2.6.2. Dalton-Puffer's (2007) framework of academic language functions

By referring to the concept of "communicative competence" by Hymes (1972: p.281), Dalton-Puffer argues that academic language functions are included in general communicative competence in the form of certain linguistic conventions. Therefore, Dalton-puffer (2007) explains this situation from a functional-notional approach by stating that certain communicative functions are established through

particular linguistic structures which are called academic language functions (p.128). Accordingly, she proposed a list of academic language functions which is a combination of certain lists suggested by various scholars. (Suhor, 1984; Snow, Met and Genesee, 1989; Chamot,1996 ; Kidd, 1999).

Table 1. *Some major academic language functions*

Analyzing	Explaining
Classifying	Hypothesizing
Comparing	Informing
Defining	Narrating
Describing	Persuading
Drawing conclusions	Predicting
Evaluating & assessing	Requesting / giving information

(adapted from Dalton-Puffer, 2007: p.129)

Dalton-Puffer (2007) points out that these functions are not categorically distributed. Some of the functions can be observed in daily communication like narrating and informing but still, they have a high frequency in terms of usage in academic settings. She concludes that there are strong connections between academic language functions and thinking skills and claims that investigating the linguistic manifestations of cognitive thinking skills would be a fruitful area of research because the existing body of research is mainly based on written discourse rather than spoken academic discourse (p.127-129). Expectedly, she revised this list in 2013, and changed the term" academic language functions" into "cognitive academic language functions" (Dalton-Puffer, 2013: p. 234), which will be examined in detail in the following sections.

2.6.3. Previous studies on academic language functions

Academic discourse functions have been studied by different researchers in different contexts. Bailey et al. (2002) investigated the construction of learning in elementary science classes through the use of academic language functions used to

show knowledge, cognitive strategies and epistemological stance. It was found out that functions of description, explanation, comparison, and assessments were highly used in the lessons. Student-led utterances were also found to be rich in terms of the use of five language functions: explanation, description, comparison, questioning, and commenting (2002: 29–30). Likewise, Dalton-Puffer (2007) studied the academic language functions by referring to the list she proposed, especially in defining, hypothesizing, and explaining through the observation of 40 CLIL lessons. The analysis was based on some principles like the extent to which they had been defined in the literature for the function of defining, the degree of linguistic complexity they involved for the function of hypothesizing and their expected ubiquity for the function of explaining (p.168-169). In particular, the function of explaining was also studied by various scholars (Lemke, 1990; Dalton-Puffer 2007; Smit, 2010; Evnitskaya, 2012). Subsequently, Lackner (2012) focused on the discourse functions in history lessons in CLIL settings by referring to functions of defining, classifying, explaining and describing. It was concluded that these functions, especially classifying and describing, were rarely observable in overall discourse of those lessons (p.103).

There have also been other studies regarding the functions of discourse markers and some specific linguistic structures. Dafouz and Nuñez (2010) studied the functional roles of discourse markers (DM) used in CLIL lessons. They found out that the use of DM in lectures had a bunch of functions such as signaling and creating a clearer discourse structure in terms of organization of lectures (p.230). Simpson (2004) conducted a study on the functions of high-frequency multi-word clusters and found out that they were useful in terms of focusing the discussion, negating a point, or introducing complexities (p.60). In a similar manner, the use of discourse markers in terms of signaling shifts in discourse was examined by (Swales and Malczewski, 2001; Crawford and Camiciottoli, 2004). In another study, the role of creating a schematic knowledge through the use of academic language was investigated by Givon (1995) and it was found out that students needed to have a mental map featuring as a “sequential-hierarchic” network-structure” to connect different steps of discourse (p. 64). Flowerdew and Miller (1997) focused on various ways to enhance students’ comprehension in academic lectures and came up with the

result that features of language, especially micro-structuring, and verbal labelling of main points, had a facilitator role for students to follow the flow of lessons (p.33). Biber (2006) claimed that some language structures like modals (e.g., would and might) were used for signaling upcoming input which has also been found prevalent in The Michigan Corpus of Academic Spoken English (MICASE) lectures for the purpose of expressing possibility (p.103).

For Turkish context, Ataş (2012) examined the discourse functions of code-switching of both lecturers and students in Turkish tertiary EFL classes. It was concluded that code-switching was mostly done based on the use of discourse markers for social and educational functions. (p.171-175). Similarly, Horasan (2013) investigated the act of code-switching in Turkish tertiary EFL classes in terms of types of switches, initiation patterns and discourse functions. It was found out that the main function of code-switching was equivalence for students and comprehension check for teachers (p 83-90). As can be seen, the discourse functions were investigated in terms of code-switching behavior in both studies. However, no study conducted on general academic discourse functions has been found in Turkish context.

2.7. COGNITIVE DISCOURSE FUNCTIONS

Deriving from academic language functions, cognitive discourse functions cognitive discourse functions, are also realized through particular discursive, grammatical and lexical structures to convey content-specific subjects, which are indispensable parts of both spoken and written discourse (Dalton-Puffer et al., 2018: p.7). They suggest that the basic motive behind the design of cognitive discourse functions (CDF) is to conceptualize the discourse of classes in which language and content are given simultaneously. By this way, both language educators and content educators can have the chance to reach a “heuristic tool” in order to gain insight about language demands of teaching and assessment materials in addition to natural classroom discourse (2018: p.7). In a similar manner, Morton (2020) points out that CDF forge a link between cognitive processes/thinking and speaking/writing. This link can be seen as a “bridge” between content/curricular goals and language

manifesting knowledge and thinking through certain verbalizations (Doiz and Lasagabaster, 2017: p. 59; Morton, 2020: p.8).

Gottlieb (2016) claims that CDFs are "key uses of academic language" (p.82) suggesting that there are a number of advantages of employing them during lessons. As for the practical benefits of the CDFs**,** researchers can benefit from them by concretely analyzing them while teachers can make use of them by reflecting on their own use of CDFs and improving their teaching skills (p.59). Likewise, according to Morton (2020), a more effective delivery of content can be achieved through active use of CDFs by integrating language and content in a more principled way rather than an incidental one. Besides, it can also be useful while assessing learners' academic language proficiency, which can be utilized by teachers as well as researchers (p.11). A recent construct of CDFs offered by (Dalton-Puffer, 2013, 2016) is examined in detail in the following section.

2.7.1. Dalton-Puffer's (2013, 2016) construct of cognitive discourse functions

To come up with a more manageable and functional categorization, Dalton-Puffer (2013) offered a construct for cognitive discourse functions (CDFs) based on the idea that speech acts as verbal action, which reflects cognitive processes or strategies (p.234). In her subsequent study, she elaborated on the construct of CDFs by defining them as "verbal routines that have arisen in answer to recurring demands while dealing with curricular content, knowledge and abstract thought." (Dalton-Puffer, 2016: p.29). Indeed, both constructs are basically similar, but each category is explained and analyzed in detail in the study conducted in 2016.

The main goal of the construct, offered in 2013 and elaborated in 2016, is to conceptualize the integration of language and content by detecting verbal actions in the form of linguistic manifestations of cognitive processes. Since cognitive processes are not observable, verbalizations become their traceable reflections. These verbalizations are not only reflections of subject-specific thought processes but also, they have communicative potential concerning curricular goals (Dalton-Puffer et al., 2018: p.7-9). At this point, curricular goals are of significance because almost all

instructional practices including teacher-student interactions, written assignments, textbooks, assessment tools are shaped based on curricular goals (Dalton-Puffer et al., 2018: p.8). These curricular goals are stated through certain performative verbs like define or compare, which is shown through extracts taken from the learning outcomes of one of the observed chemistry classes within the scope of this study.

> *"**Define** basic chemical terms and rules both theoretically and practically"*
> ***"Compare** force-mass-acceleration connections"*

Dalton-Puffer et al. (2018) indicate that these performative verbs act as "speech acts" because they are expressed through verbalizations, which can be analyzed through cognitive discourse functions (CDFs). To this end, Dalton-Puffer (2013) proposed a construct for CDFs based on seven different domains each of which stands for a particular communicative intention (Dalton-Puffer et al., 2018: p. 8) which is shown in the following figure.

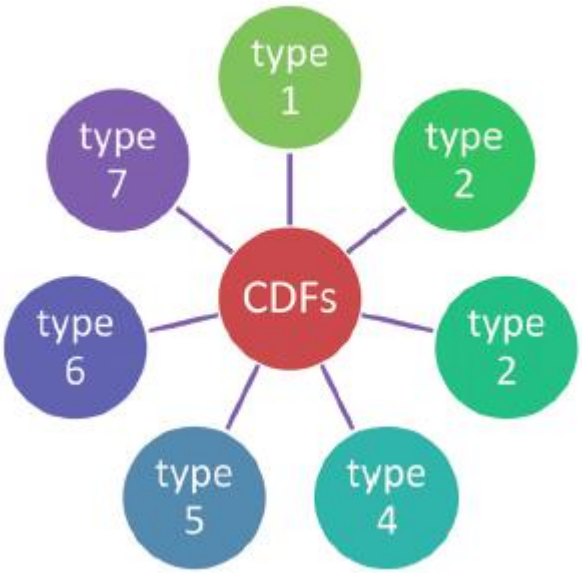

Figure 2. The construct of cognitive discourse functions (CDFs) (Dalton-Puffer, 2013: p.234)

These seven domains include different performative acts like identifying, analyzing, explaining, comparing, or hypothesizing realized by instructors or learners

during the processes of teaching, learning, and examining. A detailed conceptualization of the framework is represented in the following table.

Table 2. *Dalton-Puffer's (2013, 2016) construct of cognitive discourse functions*

CDF Type	Communicative Intention	Performative Verbs
Classify (Categorize)* (Type 1)	I tell you how we can cut up the world according to certain ideas	Classify, compare, contrast, match, structure, categorize, subsume
Define (Type 2)	I tell you about the extension of this object of specialist knowledge	Define, identify, characterize
Describe (Type 3)	I tell you details of what can be seen (also metaphorically)	Describe, label, identify, name, specify
Evaluate (Type 4)	I tell you what my position is vis a vis X	Evaluate, judge, argue, justify, take a stance, critique, recommend, comment, reflect, appreciate
Explain (Type 5)	I give you reasons for and tell you cause/s of X	Explain, reason, express cause/effect, draw conclusions, deduce
Explore (Type 6)	I tell you something that is potential	Explore, hypothesize, speculate, predict, guess, estimate, simulate, take other perspectives
Report (Type 7)	I tell you about something external to our immediate context on which I have a legitimate knowledge claim	Report, inform, recount, narrate, present, summarize, relate

(adapted from Dalton-Puffer, 2013: p. 234-235; Dalton-Puffer, 2016: p.32-33)

*The function "Classify" has been changed into the term "Categorize" Dalton-Puffer and Bauer-Marschallinger (2019) since the term "classify" has been found to be too general. An overview of each category is presented in the following sections.

2.7.1.1. The CDF "Classify" (Categorize)

Anderson and Krathwohl et al. (2001) indicate that every subject is based on a categorization to explore new elements or analyze existing ones (p.49). Therefore, classification is a crucial CDF in terms of knowledge construction. Rather than relying on clear-cut descriptions or facts, categorizations or classifications are generally based on agreement. Hence, classifying refers to pointing out relevant properties or shared patterns of something that can be linked to a broader category or concept (Dalton-Puffer, 2016: p.34). In Krathwohls' taxonomy (2001) of knowledge dimensions, he examines "knowledge of classifications and categorizations" under the title of conceptual knowledge which is defined as the respective relationship among fundamental components of a general subject which allow them to function together (p. 215).

Dalton-Puffer (2013) states that CDFs can be mutually exclusive. She argues that classifying is always a part of "define" (p. 236). Accordingly, this phenomenon has been observed in the learning outcomes of the observed lessons within the framework of this thesis. For instance, one of the learning outcomes of observed chemistry lessons is:

"***Describe*** *the differences between scalar and vector quantities*"

As can be seen, students are firstly supposed to be familiar with two different groups: Scalar and vector quantities, which can be realized through the use of the CDF "Categorize". Then, they need to describe those quantities with respect to their differences, which means that the functions "classify" and "define" can coexist in particular occasions.

In their subsequent study, Dalton-Puffer and Bauer-Marschallinger (2019) decided to change the term "classify" into "categorize" as it was found to be too general in terms of meaning.

2.7.1.2. The CDF "Define"

In the domain of *"Define",* Dalton-Puffer (2016) states there is a notion of belonging to a certain group (i.e., an X is Y). Indeed, *define* is related to *classify* as definition represents "a class membership". Moreover, "define" is a core requirement in all academic disciplines in terms of the foundation of knowledge and identification of the subject (p.36). Being relatively easy to capture thanks to their more fixed linguistic manifestations, definitions generally consist of a concept to be defined *(the definiendum),* a more general or encapsulating term *(the definiens)* and specific *differences* of definiendum (Dalton-Puffer, 2007: p.131). Dalton-Puffer (2016) formulated the function "define" by coming up with an equation which is "Definiendum=Definiens differences" (p.36). This equation is operationalized through the use of a copula structure (i.e., X is Y) with particular characteristics realized through grammatical structures like adjectives and relative clauses. The visualization of the formula is shown in the following table.

Table 3. *Definition Schema*

Content	D = superordinate term + specifying features				
Form	X	is	a	T	that is/has/does/did

(adapted from Dalton-Puffer, 2007: p .131)

As can be seen, basic linguistic manifestation for the function "define" can be realized through statements with copula be structure like "X is a T". Trimble (1985) claims that definitions can be in various sizes from a single word to a whole book (p.75). However, linguistic relations of "define" have been observed in less extensive forms in the scope of this study due its spoken nature (Dalton-Puffer, 2016: p. 36).

2.7.1.3. The CDF "Describe"

"Describe" is about elaborating on a concept by giving more details about its observable properties usually from the perspective of a third person. Description

simply means “I am telling you what I see” (Lackner, 2012: p.49). Being one of the core elements of academic thinking, the function of description is an indispensable part of academic language (Widdowson, 1979, 1983; Trimble, 1985; Mohan, 1986; Beacco et al., 2010). Descriptions are usually identifiable and can be examined under certain lexicogrammatical structures (Trimble, 1985: p.69). Accordingly, some studies were conducted to find out common features of descriptions and it was found out that there are at least three different types of descriptions which were physical, functional and process descriptions respectively (Widdowson, 1979; Trimble, 1985; Gillett, Hammond and Martala, 2009). Dalton-Puffer (2016) also mentioned structural descriptions while referring to inner mechanisms or dynamics of a concept. While physical and process descriptions are more likely to be found in science classes, all types can be observed in any discipline to a certain extent (Dalton-Puffer, 2016: p.38). The following table summarizes the types of description.

Table 4. *Types of descriptions*

Type of description	Meaning
Physical	Material and outwards characteristics
Structural	Inner parts of something and their interrelation
Functional	Purpose of a device or institution and how their parts cohere
Process	Series of steps, procedures, and their purpose

(adapted from Trimble, 1985; Dalton-Puffer, 2016)

2.7.1.4. The CDF “Evaluate”

Even though it has not been investigated on a large scale, the function of *“Evaluate”* is also among important cognitive discourse functions (Bailey and Butler, 2003; Beacco, 2010; Bloom, 1956; Chamot and O’Malley, 1994; Krathwohl,

2002; Mohan, 1986). As for Oxford English Dictionary (OED), the meaning of the verb 'Evaluate' is "determining the value or estimating the force of something in terms of something already known it means" (as cited in Dalton-Puffer, 2016: p.41). For communicative potential of the CDF "Evaluate", Dalton-Puffer (2016) suggests it means "I am going to tell my personal stance towards this. I have reasons for this position based on my evidence, my previous knowledge and beliefs" (p.41). That is to say, the CDF "Evaluate" can be based on a personal judgment to determine the value of a concept or it can include comments on the value of a concept by referring to background knowledge (Doiz and Lasagabaster, 2021, p.60).

2.7.1.5. The CDF "Explain"

Dalton-Puffer (2016) asserts that the function of *explaining* is the most complex and extended CDF type because it is possible to find a number of descriptions about the act of explaining (p.44). She proposed her understanding of the function of explain as stated in the following table.

Table 5. *Definitions of the verb "explain"*

Explain 1	a. To make something plain or intelligible b. To clear of any obscurity or difficulty c. To give details of or to unfold a matter
Explain 2	d. To give an account of one's intentions or move
Explain 3	e. To clarify the cause, origin, or reason of something

(adapted from Dalton-Puffer, 2016: p.42)

Dalton-Puffer (2016) indicates that she excluded the meaning 'Explain 1' from the current construct because it was found to be too comprehensive to be analyzed as a function. Therefore, the linguistic realization of explain in the construct includes utterances formulated to give causal and consequential relationships. As for

the communicative intention of the function, it simply means *"*I will give you the reasons and tell you the cause/s of X" (Dalton-Puffer, 2016: p.44-45).

2.7.1.6. The CDF "Explore"

"Explore" means guessing or hypothesizing about an incident that occurred in the past or has a potential to occur in the future, which is generally conveyed through the use of modals or adverbs (Doiz and Lasagabaster, 2021, p.60). Dalton-Puffer (2016) explains the communicative intention of the function as "I am talking about something which is not the here and now, and which is not a past fact either. I do not have conclusive evidence for what I say but it can serve me/us as a basis for further reasoning" (p.46). To gain more insight about the function, Dalton-Puffer (2016) emphasized the role of *hypothesizing* in the function of exploring. According to her, hypothesizing means assuming or predicting about how a particular thing is shaped or would be shaped under certain circumstances. Lexicogrammatical structures including modal verbs (e.g., *may, will, can, would*), modal adverbs (e.g., *maybe, perhaps, possibly*) and dependent clauses (e.g., *if*) are generally used in the realization of the function of explore (p.47).

2.7.1.7. The CDF "Report"

Dalton-Puffer (2016) expresses that the CDF *"Report"* is about "what happened, when, who did it and to whom and under what circumstances" (p.49). As for the communicative function of "report", she also indicates it means that "I tell you about something external to our immediate context on which I have a legitimate knowledge claim". There are a number of synonyms for the verb "report" such as recount, recount, narrate relate, present, summarize, and give an account of. The common features of these synonyms are: i) they all have an informative function, ii) they are based on a mutual background knowledge between the speaker and audience and iii) they all have a referential component (e.g., previous utterances). Reporting can mostly be observed while talking about the findings of an investigation and summarizing the topic as a final lesson closure (Dalton-Puffer, 2016: p. 49). In a

similar manner, Doiz and Lasagabaster (2021) emphasized *summarizing* the as the forefront of the function "report" (p.60). Lemke (1990) states that summaries are of importance because they are selective, which means that they are like a compilation of the most essential parts of the content. By this way, students can grasp the main points during lesson delivery (p.109).

2.7.2. Complex cognitive discourse functions

In the light of previously mentioned cognitive discourse functions, Dalton-Puffer (2013) argues that their borders are "fuzzy". That is, they may be "inclusive" of each other (p.236). As well as they can be observed individually, a function can be observed as a part of another function, too. In the scope of this thesis, some instances in which more than one function exists have been found. Breeze and Dafouz (2020) call these kinds of structures "complex combinations" (p. 88). For instance, exemplary utterances including functions like "Evaluate + Explain" or "Define + Explain" were observed in this study, which were labelled as complex cognitive discourse functions.

2.7.3. Theoretical framework of cognitive discourse functions

Academic language is usually assumed to be more demanding when compared to daily language (Harada and Moriya, 2020: p.136). Therefore, Cummins (1979) made a distinction between the terms basic interpersonal communicative skills (BICS) from cognitive academic language proficiency (CALP) (p.2). To put it simply, BICS refers to individuals' basic conversational capability in a language whereas CALP is about their ability to comprehend the language, express themselves critically in both written and oral channels, which is more complex than BICS (Cummins, 2008: p.71).

BICS is based on the development of surface skills like listening and speaking acquired through exposure to the communications taking place in daily conversations and media tools like TV or radio. Hence, it is used for communication

in daily contexts like playing with friends or having daily conversations with people (Diaz-Rico & Weed, 2006: p.56). BICS starts from birth and shows itself as a basic tool for communication in especially pre-school years (Lorenzo and Rodríguez, 2014: p.64). For second language learners working with native speakers, it takes between 5 and 7 years to develop BICS while this happens in 2 years for native speakers (Cummins, 2000: p. 58).

Just like BICS, CALP also starts from birth but differentiates from BICS through schooling as students are supposed to use language for academic purposes by using it critically and effectively to reach desired outcomes in educational settings. Therefore, CALP is mainly based on dynamics of schooling which is the reason why it includes the word "academic" (Cummins, 2008: p.72). In sum, CALP simply means "the extent to which an individual has access to and command of the oral and written academic registers of schooling" (Cummins, 2000, p. 67).

As for a comparison between BICS and CALP, BICS simply means the total occurrence of communication between two or more people in their daily life. Therefore, BICS was found to be *"context-embedded"* since communicators can have the chance to negotiate meaning by providing one another with feedback and elicit clues from context to get the message (Cummins, 2000: p.68). However, CALP is far more complex than this. CALP is based on systematic thought processes like categorizing, comparing, analyzing, and accommodating new experiences. To achieve these processes, a complex growth in a number of linguistic areas simultaneously is necessary. This growth is generally achieved through the help of an educator, generally in school settings, as opposed to BICS (Diaz-Rico & Weed, 2006: p.56). In CALP, students are supposed to interpret the coming messages accurately based on their own proficiency of language rather than negotiating meaning or getting feedback. Hence, Cummins (2000) calls CALP *"context-reduced"* (p. 68). The following figure shows the framework for context-embedded and context-reduced language activities.

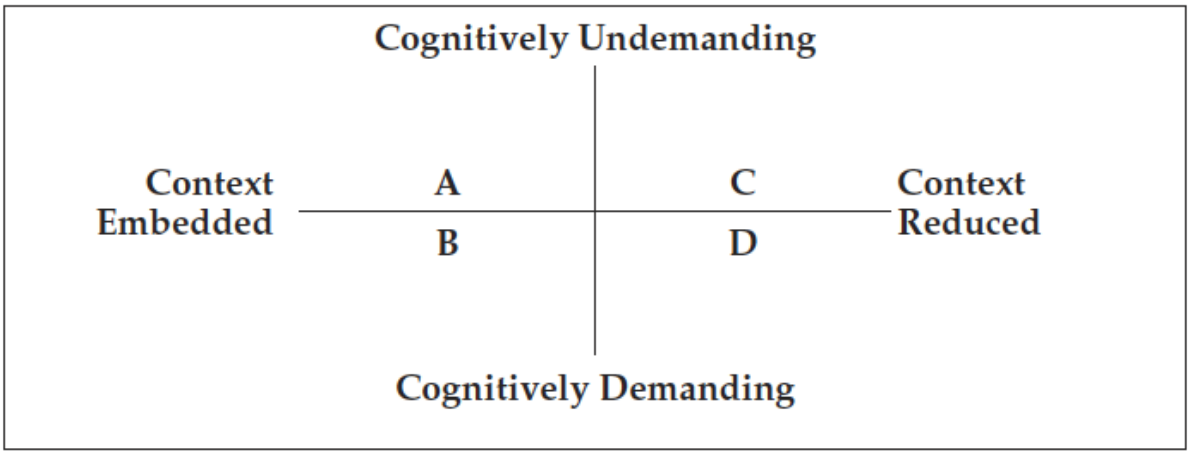

Figure 3. Cummin's (2000) framework for context-embedded and context-reduced language activities (p.68)

Cummins (2000) states that the context-embedded part of the framework is about casual conversations. Accordingly, upper parts of the vertical continuum include communicative activities in which linguistic domains are automatically activated, which requires a little cognitive involvement. Daily conversations can be included in quadrant A while taking notes from the blackboard, engaging in fill-in the blank activities in worksheets or other practice tasks like drills can be examples of quadrant B as examples of upper parts of the vertical continuum. On the other hand, context-reduced part of the framework refers to demanding linguistic tasks. Lower parts of the framework (i.e., Quadrants B and D) are involved in the context-reduced part. The tasks in this part of the framework require automatization of linguistic tools and active cognitive engagement. Persuading another person that your argument is accurate is an example of a typical tasks of quadrant B. Likewise, writing an essay based on an argument and mastering academic functions of language are examples of quadrant D, which require high level cognitive processes to reach the desired objectives without getting help from contextual cues (Cummins, 2000: p.68).

The "context-reduced" part of CALP is essential in terms of the use of cognitive discourse functions in classroom settings because CDFs play a crucial role in the activation of cognitive resources through certain linguistic structures. Leung (1996) argues that there is a direct relationship between language use and thinking

because the meanings of knowledge are mostly delivered through certain linguistic structures (p.34). At this point, CALP is closely related to CDF as CALP requires the activation of certain cognitive skills and the use of particular linguistic structures (Dalton-Puffer, 2013: p.226). That is to say, the CDF construct and CALP are interrelated terms. Cummins (1999) suggests bilingual educational programs should be careful about the inclusion of three elements: i) cognitive skills, ii) academic content, and iii) critical language awareness (p.1), which are also important elements in terms of understanding and investigating CDFs.

As an instance of a classroom-based study focusing on cognitive or academic discourse from a CALP perspective, Lorenzo and Rodríguez (2014) studied CALP in CLIL settings. The aim of their study was to observe the development of academic language in CLIL immersion programs. To this end, they formed a corpus consisting of 244 historical narratives and found out that lower grade learners presented an insufficient language having inadequate dependents clauses and other coordinate phrases and it was observed that this insufficient language was improved in higher grades, which represents the development of CALP through education (p.70).

Another dimension on which the CDF construct is based is systemic functional linguistics (Dalton-Puffer, 2013: p.228). The construct is specially designed for the verbalizations of certain cognitive processes activated while engaging in content and achieving curricular goals. As it is not possible to directly observe those cognitive processes, these verbal actions function as the ways in which actual cognitive processes are concretized. They are not only linguistic manifestations of cognitive processes, but they also have communicative value (Dalton-Puffer et al, 2018: p.9). Halliday (1993) calls this phenomenon "language as action" from a systemic functional linguistics (SFL) perspective (p. 107). In a similar manner, Janzen (2008) suggests that academic language can be analyzed through a systemic functional linguistics approach (p.1015). Furthermore, Temple Adger and Wright (2015) claim that SFL is conducive to the examination of language use in various academic disciplines like how language is used in science versus history classes, which can contribute to students' academic proficiency (p.863) as language use in those classes can be modified to increase students' success.

In this regard, the role of cognitive discourse functions is crucial since they are the determiners of communicative goals of discourse participants while working on curricular goals. Dalton-Puffer (2013) also states that we tell what we think about our environment through our use of language. Namely, our cognitive processes show themselves through our linguistic utterances (p.229). Briefly, it can be stated that the construct of CDF relies on Systemic Functional Linguistics (e. g. Halliday, 1993, 1994; Christie, 2002; Kääntä, 2021) as it focuses on the relationship between cognition and language (p.3).

2.7.4. Previous studies on cognitive discourse functions

There have been some studies concerning cognitive discourse functions most of which are focused on CLIL settings. For instance, Evnitskaya and Dalton-Puffer (2020) investigated learners' patterns of using CDFs to find out whether their cognitive level and L2 proficiency match or not. Certain speech acts including classifying, comparing, and contrasting were analyzed under the title of 'categorizing' and it was found out that students tended to use more comparisons than classifications. To find out how categorizing is operationalized in classroom discourse, certain lexicogrammatical choices for comparison (e.g., the same, similar, more, and less) and contrast (e.g., the difference between, instead of) were also detected.

There have been a bunch of theses regarding cognitive discourse functions. Kröss (2014) analyzed six physics lessons in CLIL settings to find out the types of CDFs observed, the realizers (i.e., teachers and students) and the contexts in which CDFs are performed (i.e., language, subject, meta-language, and meta-subject). It was found out that there was not an equal distribution of CDFs across the lessons as the function "Define" was mostly observable while "Classify" and "Evaluate" were rarely preferred (p. 81-83). Followingly, Hofmann and Hopf (2015) conducted a study regarding cognitive discourse functions in Austrian CLIL biology lessons in secondary level. Based on eight hours of lesson recordings, it was concluded that CDFs were frequently employed by teachers, which fostered communication and

discussions in the observed lessons (p. 206-211). Lechner (2016) focused on secondary level Austrian EFL classes in terms of the use of cognitive discourse functions. A small corpus consisting of eight lectures was compiled within the scope of that study. Among the types of CDFs employed in the observed classes, "Define" was the most used one whereas "Explore" was the less occurred one because it was claimed that the CDF "Explore" necessitates the use of complex lexicogrammatical structures. As different from other studies, it was found out that most CDF were realized by students, not teachers. Besides, textbooks were found to be rich in terms of including CDFs (p. 112-113). Lastly, Brückl (2016) investigated six Austrian CLIL Economics lessons in the secondary level to find out the patterns of CDFs employed in lessons, the realizers (i.e., teachers and students) and linguistic representations to realize those CDFs. She concluded that CDF were frequently employed by both teachers and students and "Define", and "Report" were the most preferred CDFs (p.88-91).

As the combination of the aforementioned studies, Dalton-Puffer et al. (2018) carried out a project to base CDFs on an empirical framework. In the scope of this study, a more in-depth analysis of the discourse of the observed classes for the theses was done to find out occurrences and ratios of CDFs and reach a more generalizable result. It was found out that a range of CDFs were used in those classes, but they were not equally employed. Furthermore, when they were employed, the interlocutors were not aware of the fact that they had used CDFs in most cases. Almost in all classes, the CDF "Describe" was the most observed one followed by "Explain" and "Define" whereas "Explore" and "Evaluate" were occasionally observed (p.26).

In another study, Kääntä, Kasper and Piirainen-Marsh (2016) examined classroom practices while defining a concept in CLIL physics classrooms. Specifically, the introduction of a physics law through definitional practices used by the teacher were focused. They did not refer to the CDF construct offered by Dalton-Puffer (2013, 2016). Nonetheless, this study is of importance in terms of the realization of definitions in CLIL classrooms. It was found out that the teacher

supported the definitions with multimodal resources including the visuals, board, paralinguistic features like gestures or movements (p.713).

In a subsequent study, Kääntä (2018) investigated the comparison between definitional practices of history and physics lessons by focusing on the subject-specific language from a multimodal perspective. This time, she took the CDF construct offered by Dalton-Puffer (2013, 2016) as the reference. She concluded that definitions were done in a number of ways rather than only through formal or canonical ones. She also found out that the physics lecturer used lots of drawings on the board to give definitions while the history teacher used realia to contextualize definitions which are in line with the notion of multimodal practices (p.30).

Lastly, Dalton-Puffer and Bauer-Marschallinger (2019) conducted a study regarding the use of CDFs by students to analyze the role of CDFs in terms of gaining competency in history. For the purpose of data collection, two lecture units about the Industrial Revolution were recorded together with both oral and written contributions of students. Then, the prevalence of CDFs was compared to a previously developed construct, Congruence of historical competences (FUER-model). The results showed that there was a significant correlation between CDF and historical competences, which suggests that CDFs can function as an "interdisciplinary" tool by making language and history interrelated. It was also observed that students not only used CDFs in their writings, but also, they use them in their oral classroom interactions (p.55).

2.8. COGNITIVE DISCOURSE FUNCTIONS AND EMI

In consideration of previously mentioned studies, cognitive discourse functions have been investigated by various scholars in various settings like CLIL, EAP and EFL. However, the number of studies focusing on academic discourse functions in EMI classes is not sufficient. However, cognitive discourse functions are essential in terms of understanding EMI classroom discourse because the CDF construct can help teachers to have a particular framework about the integration of

content and language by “making language a natural concern of non-language educators” (Dalton-Puffer & Bauer-Marschallinger, 2019: p.33)

As for an investigation of the CDF “Explain” in EMI settings, Martín del Pozo (2017) focused on the cognitive function of the act of explaining, in EMI classes. Six EMI lectures in a Spanish university were videotaped in the framework of this study. Then a corpus created based on the transcription of those lessons. It was found out that the use of the CDF “Explain” was bound to discipline. For example, in one of the lessons focusing on consumer behavior, there was a bigger place for explanations because of the causal relationships among the steps of the process included in the topic (p.116).

Breeze and Dafouz (2017) investigated the role of CDFs suggested by Dalton- in students’ writings at tertiary level to find out whether there were differences in the use of CDFs depending on high and low-level exams and medium of instructions (i.e., Spanish and English). They came up with the result that students succeeded in using CDFs (i.e., Describe + Classify and Describe + Explain) in their high-level responses but it was not the case for low-level exams, irrespective of medium of instruction. The pedagogical implication was that implementation of the CDF construct to EMI exam questions led to a satisfactory level of student performance in exams (p.89).

Sobhy (2018) conducted a study concerning the ways of supporting literacy in tertiary EMI classes by focusing on the operationalization of the CDF “Define” in terms of learner use. Within the framework of this study, a range of activities in which students were supposed to engage in providing definitions were designed. The results show that students made use of the CDF “Define” in their written definitions. Besides, it was found out that the realization of the CDF “Define” can be an effective way of promoting the process of learning in EMI classes (p.110).

In a very recent study, Doiz and Lasagabaster (2021) investigated the role of teachers’ use of CDFs while constructing content knowledge in EMI settings at tertiary level. They took the CDF construct proposed by Dalton-Puffer in 2016 as

basis and analyzed the spoken discourse of six history classes. It was found out that a number of complex CDFs, which are the mixture of more than one CDF at the same time, were employed by teachers to foster communicativeness of the classes and enhance students' level of acquisition of history.

As can be seen in the aforementioned studies, there are a few studies regarding CDFs in EMI. It seems that this gap needs to be supported by further studies.

2.9. CONCLUSION

In the light of previous studies, it is apparent that teaching through English is a prevalent phenomenon all around the world. There are some basic models in which English is used as the medium of instruction to teach content (i.e., CLIL, CBI and EMI). Among these models, EMI has become prominent especially in the last decades. In this newly emerging research field, there have been a number of studies most of which are about the attitudes, perceptions or challenges experienced by stakeholders including administrative authorities, lecturers and students. However, this tendency creates a gap in the field of actual classroom discourse in EMI.

Classroom discourse in EMI, it is essential because it has been found out that it can help students follow and understand lectures. CDFs are among the fundamental components of academic discourse. They show how speakers' minds are linguistically represented. The realization of learning objectives and an efficient delivery of lectures are closely related to an appropriate use of CDFs. Therefore, it is crucial to investigate how cognitive discourse functions are conveyed through the use of certain linguistic structures.

Notwithstanding, cognitive discourse functions in EMI settings is one of the least explored areas in the field of EMI. Hence, it is obvious that there is a need for newer studies based on a careful scrutiny of cognitive discourse functions in EMI settings, which is the basic starting point behind this thesis.

CHAPTER 3

3. METHODOLOGY

3.1. INTRODUCTION

The aim of this chapter is to demonstrate the methodology of this study. Firstly, information about the research design, setting and participants is presented. Secondly, the steps of data collection are examined. Then, the process of data transcription, coding and analysis with the help of particular technological tools is discussed in detail. Lastly, how the validity and reliability of the data analysis process are ensured is explained.

3.2. RESEARCH DESIGN

Zappa-Hollman and Duff (2019) suggest that research design should be chosen according to the research question of a study (p.1036). The research questions of this study sought to the distribution of CDFs, the common linguistic patterns in their realization and their role in the achievement of key competences of the observed lessons. Because those questions required an in-depth analysis of classroom discourse, a qualitative design was preferred. As for this study, all of the research questions are intended to examine language use in EMI classes which requires a rich amount of qualitative data through an in-depth classroom observation in order to draw detailed conclusions. Mackey and Gass (2005) define qualitative research as "descriptive data that does not make (regular) use of statistical procedures" (p.62). With the preference of qualitative research design, richer description of the topic, natural and holistic depiction of the setting, in-depth and more open-ended contributions of the participants can be reached (Mackey and Gass, 2005: p.63). Furthermore, the amount and function of certain discursive practices can be acquired through a qualitative research design (Zappa-Hollman and Duff, 2019, p. 1034).

Qualitative classroom research focusing on language paves the way for

further pedagogical implications for instructors by establishing a connection between theory and practice (Ellis, 2012; Harbon and Shen, 2015; Lightbown, 2000; McKay 2006; Nunan and Bailey, 2009). Moreover, although there were just a few publications only a couple of years ago, the number of qualitative studies has been increasing in the field of English medium instruction (EMI), which is promising because EMI has become an ever-growing phenomenon all around the world (Zappa-Hollman and Duff, 2019: p. 1039).

3.3. SETTINGS AND PARTICIPANTS

3.3.1. Settings

In the scope of this study, three EMI lectures at two different state universities in the Marmara region in Turkey were chosen. As the method of sampling, convenience sampling was preferred for both universities and classes. Mackey and Gass (2012) state that convenience sampling needs to be preferred if the participants meet certain criteria such as physical proximity, availability, and accessibility (p.81). As far as institutional permissions concerned, only three lecturers from two different universities volunteered to participate in this study, which necessitated the preference of a convenience sampling.

One of the participant universities (henceforth U1) is a state and technical university located in the Marmara region in Turkey. Having been established in 1992 as an advanced technology institute and transformed into a university in 2014, U1 has four faculties (i.e., engineering, basic sciences, architecture, and business administration) consisting of 18 departments. There are also 10 institutes offering a variety of graduate programs. According to the Times Higher Education World University Ranking, U1 was ranked 601-800th in 2018. The medium of instruction is 100% English in 11 departments while it is 30% English in four and 100% Turkish in three. In order for students to commence their departmental studies, they are supposed to take the proficiency exam held by the institution. The minimum score the students should get is 70 out of 100. The students who get a score below 70 are required to attend a one-year English preparatory program.

The other participant university (henceforth U2) is also a state university located in the Marmara region in Turkey. U2 was established in 1992. Since then, it has hosted more than 80.000 students. It has 19 faculties consisting of 81 departments in addition to one college, 21 vocational schools, and three institutes offering various graduate programs both in master and doctoral level. The medium of instruction in U2 is Turkish but it offers 30% English for some programs in particular faculties like engineering, economics, and administrative sciences. Students who enroll in a program which offers a partial EMI education (i.e., 30% English) are supposed to take the proficiency exam held by the school of foreign languages. Students are supposed to get a minimum score 65 out of 100 to pass the exam, otherwise they need to attend English preparatory program lasting one year. The general information about both universities is shown in the following table.

Table 6. *General information about the participant universities*

Abbreviation	Type	Foundation date	Medium of Instruction	Undergraduate programs	Institutes	Graduate programs
U1	State	2014	Mostly English, 30% English or 100% Turkish in some programs	18	10	33 M.A (with thesis) 3 M.A. (non-thesis) 18 PhD programs 1 joint PhD program
U2	State	1992	Mostly Turkish, 30% English in some programs	81	3	120 M.A programs (with thesis) 17 M.A. programs (non-thesis) 99 PhD programs

Even though it seems like the medium of instruction in these universities is

not 100% English, the observed lectures were full EMI classes in accordance with the aim of the study.

3.3.2. Participants

EMI teachers are generally expected to be skilled in two different domains: i) discipline-based competency (Jiang et al., 2016: p.8) and ii) communication/interaction based academic competency (Kim, Kim, and Kweon, 2018: p.113). Hence, it is important for lecturers to implement a "language-conscious" EMI program (Bjorkman, 2010: p 78, 2011: p 961; Schmidt-Unterberger, 2018, p. 536). Therefore, an ideal EMI implementation is called EMI Bermuda Triangle (Lauridsen, 2015) because it requires a bunch of skills simultaneously. At this point, EMI lecturers have a pivotal role in terms of delivering the content in a way through which students can grasp the content effectively without dealing with-language-related problems.

In the framework of this study, there are three participant lecturers having different teaching and education backgrounds. Initially, they were reached through email and informed about the study. In face-to-face meetings, they signed the consent form in which the purpose and procedures of the study were stated. Besides, the study and data collection processes were approved by the ethical committee of Kocaeli University (date: 25/03/2021, meeting number: 2021/04, decision number: 17).

The first participant teacher (hereinafter T1) is working at U1 as assistant professor at the department of chemistry. She completed her B.A., M.A., and PhD degrees in the field of chemistry at a well-known state university located in the Marmara region in Turkey. She has been abroad as a visiting researcher. She has less than five years of teaching through EMI experience.

The second participant teacher (hereinafter T2) is also working at U1 as an associate professor at the department of chemistry. He completed his undergraduate

education in Turkey and holds his graduate degree from abroad. He has seven years of teaching through EMI experience.

The third participant teacher (hereinafter T3) is working at U2 as a full professor at the department of physics. He completed his undergraduate education in Turkey and holds his graduate degree from abroad. He has been delivering physics courses through English at faculty of engineering at U2. He has more than 20 years of teaching experience, including teaching through English for more than 10 years.

3.4. DATA COLLECTION PROCEDURE

Qualitative research generally relies on more than one method and source of data in terms of triangulation and boosting the validity of analysis (Friedman, 2012: p.186). Ellis and Barkhuizen (2005) state that qualitative data are “rich, thick and deep data” which gives information about the natural attributes of something while quantitative data is generally measurable and countable (p.253). To collect qualitative data in order to gain detailed insight about the classroom discourse and the use of cognitive discourse functions in the participant EMI classes, 32 hours of lessons were observed. As Mason (1996) stated, the term “observation” generally means “methods of generating data which involve the researcher immersing [him or herself] in a research setting, and systematically observing dimensions of that setting, interactions, relationships, actions, events, and so on, within it" (p. 60). The data collected through observations are valuable in terms of obtaining a rich amount of data because it is possible to reach “in-depth” and “multilayered” information about the issue to be explored especially through repeated observations. (Mackey and Gass, 2005: p.176).

As for the process of observation, I got in touch with the dean of the faculty of basic sciences in U1 with the help of my supervisor. With the dean’s guidance, I sent emails to various lecturers at the department of chemistry. Two of them responded positively and I went to the institution and talked with them face-to-face to inform them about the study and give the consent forms. They read and signed the

forms, and we scheduled the observation period. I got in touch with the third participant lecturer with the help of one of my professors . He also read and signed the consent form, and I started my observations as I planned. In the consent forms, general information about the study and confidentiality issues were indicated. However, there was only surface knowledge about the things I desired to explore in order to avoid the "Halo effect" which means the participants' desire to please the researchers by giving the desired answers or showing the expected behaviors (Mackey and Gass, 2005: p.14). Otherwise, the lecturers could have changed their language habits to provide the data that I desire to collect. Therefore, I told them that I would investigate their language use without touching upon the detailed explanation of cognitive discourse functions. The observations took place in the fall semester in the 2019-2020 academic year. The observations in U1 lasted approximately five weeks whereas the ones in U2 lasted for three weeks. All participant lecturers' lessons were observed on a weekly basis.

Concerning observations, Labov (1972) proposes the term "the observer's paradox", which refers to the changes in participants' behavior as a result of observer's presence (p.209) which is usually at stake in classroom observations. The preference over audio-recording as the data collection procedure is usually found to be less obtrusive which minimizes the observer's paradox. Furthermore, I conducted my observations in accordance with the concept of "non-participant" observation to keep the dynamics of the lessons as natural as possible and minimize "the observer's paradox".

Based on the audio-recorded data, a corpus of the observed EMI lectures has been composed to be analyzed. In total, 1897 minutes, which is approximately 32 hours of lessons from three different lectures were recorded. The lessons observed in U1 were chemistry classes in the faculty of basic sciences. The T1's class (hereinafter L1), is a departmental chemistry class for students studying at the department of chemistry. The T2's class (hereinafter L2) is again a general chemistry class, but it is designed for students coming from different disciplines. Thus, it is not a departmental course. The T3's classes (hereinafter L3 and L4) are physics and dynamics classes offered for the students studying at the faculty of engineering. The

number of total words in the corpus has been presented separately for each different subject and teacher in the following table.

Table 7. *Information about the collected corpus*

Teacher	Name	Abbreviation	University	Level	Minutes	Words
T1	Chemistry (Departmental)	L1	U1	Undergraduate	494	29.960
T2	Chemistry (Across disciplines)	L2	U1	Undergraduate	622	24.446
T3	Physics	L3	U2	Undergraduate	625	54.022
	Dynamics	L4	U2	Undergraduate	156	10.207
TOTAL					1897	118.635

3.5. DATA ANALYSIS

Dörnyei (2007) states data analysis is the step in which "the process is turned into a product" (p. 257). As for the data analysis process of this study, a corpus-based discourse analysis was carried out. Levinson (1983) states that discourse analysis is one of the main approaches to analyze naturally occurring communication (p.286). Additionally, Corpus Linguistics (CL) studies are the ones in which the use of linguistic structures is investigated in context (Biber et al., 2006, p2). Furthermore, Walsh (2006) argues that discourse analysis (DA) studies are based on structural-functional linguistics since classroom discourse is analyzed according to linguistic patterns and functions (p.48). With regard to these, the linguistic structures to realize CDFs in different contexts (i.e., *chemistry, physics, and dynamics lessons*) were scrutinized by detecting common linguistic patterns and their functions. Additionally, Biber et al. (2007) state that corpus-based discourse analysis studies can be conducted both quantitatively and qualitatively (2007: p.36). Similarly, this study

also includes some quantitative part even though it mainly relies on qualitative tools for analysis. As for the quantitative part of the data analysis process, frequencies, and distributions of CDFs in each lecture were calculated so that qualitative interpretations could be done better. Qualitative interpretation of the findings is one of the core parts of a corpus analysis study (Biber et al., 1998: p.4). Therefore, the linguistic structures used to realize CDFs and the achievement of key competences through the use of CDFs were analyzed and qualitatively interpreted. Regarding linguistic structures, Lemke (1990) argues that there may be a variety of ways of saying "the same thing" (p.97). Therefore, a range of different linguistic patterns were found out to achieve the same CDF. He claims that fixed word choices are not effective in classroom discourse. Instead, preference of different word choice or grammatical structures expressing the same core meaning is more helpful in terms of student's comprehension. Students can have the chance to fill the gaps in their comprehension through the understanding of common linguistic patterns. If they know the pattern (i.e., certain wordings or linguistic structures), they can predict accurately what comes next. Therefore, common linguistic patterns act as signals for upcoming information as well as they make connections to the previously uttered statements (1990: p .91). Moreover, Lemke (1990) indicates that through analyzing the linguistic patterns used in the classroom discourse, it is possible to find out whether curricular needs are met because curricular objectives are generally stated via certain linguistic structures (p.94). In the framework of this study, the way the learning objectives of the observed classes (i.e., *Describe scalar and vector quantities),* was investigated through the use of CDFs.

Regarding the advantages of adopting a corpus-based discourse analysis approach, it can be stated that it is bias-free (Baker, 2006: p.12). That is to say, the data collected for the study was not particularly selected in accordance with the researcher's interest to confirm some personal biases. Instead, the collected data of the study is based on naturally occurring classroom data, which allows for a free and objective analysis. Besides, the recursive nature of discourse, what Baker (2006) calls "the incremental effect of discourse (p.13) enables researchers to detect prevalent patterns to reach more transferable results.

3.5.1. Data Transcription

As the first step of the process of data analysis, the collected data was transcribed. As Lemke (1990) states, "transcription is already a preliminary kind of data analysis (p.239). Dörnyei (2007) points out that transcription of a one-hour recording may take 5-7 hours depending on the quality of it. Taking into consideration the fact that 32 hours of recording were collected within the scope of this study, the transcription process was time-consuming and weary. Due to some inconveniences regarding the quality of some audio-recordings, most recordings were listened to more than once in order to come up with a clear transcription. Moreover, all the recordings were transcribed although my intention was to analyze only the use of cognitive discourse functions, because I did not want to take the risk of missing some functions. Besides, I personally avoided using a software or computerized tool for transcription to prevent potential mismatches or inaccuracies. Therefore, all data were transcribed manually through Google Docs. In total, 266 pages of transcription were acquired, which equals 13 pages on average per lesson. Lesson breaks were not included in transcriptions but there were some pauses during lectures, which were also indicated through transcription conventions.

Transcription conventions are efficient tools in terms of providing a systematic written representation of oral data. They can also be conducive to coding and finding examples from the data while working on the results part of the research (Mackey and Gass, 2005: p.222-223). Factors like body language, the speed of delivery, and prosodic features like changes in turn-takers' pitches were not included in transcription in accordance with the aim of the study. Therefore, a modified version of a basic but functional transcription convention adapted from De Guerrero and Villamil (2000) was taken as a reference.

Table 8. *Transcription conventions used in the current study*

Transcription symbol	Meaning
T1, T2, T3	Lecturer turns
S1, S2, S3…	Student turns
Ss	More than one student at the same time
[ ]	Overlapping speech
(.)	A sequence of dots indicates pauses
“ “	Quotation marks indicates the lecturer is reading from a textual material
(( ))	Laughs and giggles
[TR]	Utterances made in the mother tongue
(?)	Incomprehensible word

(modified after being adapted from De Guerrero and Villamil, 2000: p.56)

3.5.2. Data Reduction

Ellis and Barkhuizen (2005) state that data reduction is among the necessary steps of the process of data analysis (p.261). There were some occasions in which the medium of instruction was shifted to Turkish even though the length of those periods was quite short. In line with the aim of this study, those periods were taken out from the collected corpus. Casual conversations between students or students and the teacher were not included in the analysis period but were not taken out of the corpus in order not to distort the flow of the lessons, which would harm the comprehensibility of the transcriptions.

3.5.3. Data Coding

Coding is a technique to reduce the considerable amount of data into manageable parts for the purpose of analysis (Ellis and Barkhuizen, 2005: p.253). Accordingly, after the data transcription process was over, the transcribed and reduced data were coded through the software NVivo. Dörnyei (2007) states that the use of NVivo has been gaining acceleration and popularity among researchers in recent years (p.264). The use of NVivo or other tools can contribute remarkably to the management and organization of the collected data (Baralt, 2012: p.227). The use of software tools in the processes of data transcription is called coding and analysis computer-aided qualitative data analysis (CAQDAS) (Dörnyei, 2007: p262). Taking into consideration the fact that researchers need to deal with a huge amount of qualitative data, CAQDAS is helpful in terms of speed, efficacy, storage, user-friendly facilities, sensitive coding, and transparency (p.262-265). There are also some dangers of using CAQDAS such as threatening researchers' genuine creativity, risk of losing data, working in front of computers instead of papers, technological literacy, and especially the risk of overcoding (p.266-267). Personally, overcoding seems more serious than others among these problems because Richards (2005) states that researchers may overdo coding when they are not sure whether they code a theme or there are no emerging themes, which may eventually deteriorate or even destroy a study (p.119). To avoid such a problem, interrater reliability was ensured in this study, which is presented in detail in the section 3.6. Validity and Reliability.

Before the coding process started, I examined all the studies carried out in this field by various researchers and investigated what kind of sentences was coded under each CDF type. Then, I prepared a coding manual (see Appendix 1) for the external coder. For coding process, Dörnyei (2007) argues that there are two coding steps which are called initial and second level coding (p.251-252). In initial-level coding, the transcribed and reduced data were read carefully and emerging patterns, together with their realizers, were coded in accordance with the CDF construct proposed by Dalton-Puffer (2013, 2016). At this step, only salient CDFs were coded, and no keyword search was done. Then, the coded data were re-read at least three times and unnoticed CDFs were also coded as the second level coding. Breeze and

Dafouz (2017) state that there are also complex CDF which are combinations of more than one CDF (e.g., Describe + Explain or Describe + Classify) (p.88). Similarly, in addition to single CDF, complex CDF consisting of the mixture of more than one CDFs were also detected and coded even though their ratio was lower compared to single CDF. Additionally, there were a few sentences in which translations were done for the purpose of giving definition. These kinds of sentences were coded as "Define + Translate". While coding, the following abbreviations were used.

Table 9. *Coding abbreviations*

CDF Types	Abbreviation
Categorize	CA
Define	DF
Describe	DS
Evaluate	EV
Explain	EA
Explore	EO
Report	RE
Complex CDFs	**Abbreviation**
Define + Explain	DF + EA
Define + Describe	DF + DS
Describe + Explain	DS + EA
Explore + Explain	EO + EA
Categorize + Explain	CA + EA
Define + Categorize	DF + CA
Evaluate + Explain	EV + EA
Define + Translate	DF + TR
The realizers of CDF	**Abbreviation**
Teacher	T
Student	S
Teacher and student	TS

(adapted from Kröss, 2014: p.36-38)

For the second-level coding, a keyword search based on the performative verbs suggested in Dalton-Puffer's (2013, 2016) CDF construct was carried out. By this way, whether the sentences that include target keywords were acting as a cognitive discourse function or not was investigated. When I was sure that they were cognitive discourse functions, those sentences were also coded.

After the coding process was completed, the realization of the cognitive discourse functions were carefully scrutinized in terms of the lexicogrammatical patterns, which forms the basis for the discourse analysis. Then, common linguistic patterns for each category were investigated depending on the use of common lexicogrammatical structures (e.g., Subordinate clauses, copula be, passive voice). The prevalent linguistic structures were color-coded by using Microsoft Word and then visuals representing those common linguistic structures were created. These common patterns were also cross checked by the external coder and my advisor in order to make sure that they were appropriate.

In order to make the process of analysis more efficient and clearer, visualizations regarding the CDFs and lexicogrammatical themes were created through computerized tools NVivo and Microsoft Word. Ellis and Barkhuizen (2005) states that visualizations are conducive to understanding and interpretations of the results as they help the researcher to interpret the findings better and guide readers to gain more insight about the study (p.70).

3.6. VALIDITY AND RELIABILITY

Among the crucial assets of academic studies, validity and reliability were reconceptualized by Lincoln and Guba (1985). Regarding the concepts of validity and reliability of academic studies, they offered some domains to be focused which were credibility, transferability, dependability, and confirmability. They suggested a bunch of methods to meet the requirements of those criteria like triangulations concerning data collection and researchers, peer debriefing, persistent observations,

and audit trail (p.305-327). All those suggestions were tried to be performed in each step of this study to ensure validity and reliability.

Credibility refers to internal validity of a study (Friedman, 2012; p.194). Correspondingly, triangulation of the data collection procedure was ensured through audio recordings, field-notes, and short question-answer sessions with the participant teachers concerning their language use and students' participation and performance in EMI settings. As for the duration of the observation Seedhouse (2004) suggests that observing between five and ten lessons can provide a reasonable data for researchers (p.87). Within this respect, I tried to keep the period of observations as long as possible to enhance the credibility of the study and I observed 20 lessons which equals to 32 hours of audio-recordings. Therefore, it can be stated that the length of observation is above average. With respect to the size of the collected corpus, Hunston (2002) states that the size of a corpus is "contentious" (p.26) as there is no agreement on an optimal number for spoken corpus. Walsh (2006) used a small spoken corpus which was based on the classroom recordings of TESOL classes in a British university consisted of 100.000 words in his study (p.1). The total number of words in the collected corpus of this study is 118.635, which is above average when Walsh's perspective is taken as a reference.

To ensure dependability, which is the reliability of the study (Lincoln and Guba, 1985, p.316), peer-debriefing sessions were held with the supervisor regarding emerged codes for CDFs and linguistic patterns to enhance consistency of the results. Inconsistencies concerning the merged codes for CDFs and linguistic themes were discussed and modified accordingly. Therefore, the agreement between the supervisor and researcher was sustained. Furthermore, the interrater reliability of the results was calculated within the framework of researcher triangulation. Interrater reliability is an important aspect to be ensured (Berg, 2002; Lynch, 2003; Mackey and Gass, 2005; Loewen and Philp, 2012; Polio, 2012; Révész, 2012; Friedman, 2012). An external coder, who completed her B.A. and M.A. degrees in the field of foreign language education, was requested to analyze and code the data. Loewen and Phlip (2012) argue that there is no clear-cut rule regarding the amount of the data to be double-coded. However, 15-20% is considered to be an acceptable ratio especially

if the agreement between the researchers and external coder is high. (p.68). Accordingly, the external coder was given randomly chosen 53 pages of transcribed data, which is 20% of total 266 pages. Regarding the coding process of external coder, Révész (2012) suggests that a clear definition of code categories is significant (p.213). In this regard, I prepared a manual regarding each CDF type, their communicative intentions, and sample utterances and submit it to the external coder (see Appendix 1). Then, we went over the manual together as well to make sure that she understood the construct completely. Then, she started to code the transcribed data. For each category, the interrater reliability was calculated separately. In this regard, the ratios of agreement between the external coder and researcher were 100%, 96%, 92%, %94, %95, 100%, and 100% for the CDF types *Categorize, Define, Describe, Evaluate, Explain, Explore and Report*, respectively. The reached percentages seem acceptable because Mackey and Gass (2005) states that percentages above 75% are regarded as "good", but the ideal percentage is above 90% (p.244). For the times when there were mismatches between my coding and that of the external coder, we negotiated those parts but still, we decided to stick to our own interpretations, which are reflected on the reached percentages.

Transferability is about the generalizability of the research results, which is also called external validity. Lincoln and Guba (1985) state that naturalistic studies can only provide detailed and in-depth descriptions of the phenomenon to be observed rather than generalizability. The job of researchers studying on a naturalistic context is not to come up with an index of transferability. Instead, their job is to present a database from which judgments concerning transferability can be inferred. (p.316). In this regard, I aspired to provide a detailed analysis by observing a reasonable amount of EMI lectures. Nonetheless, I cannot claim that the findings of this study are true for other EMI contexts. The results of this study can be used for transferability purposes by other researchers. (i.e., comparing their own results with mine).

Confirmability is ensured when researchers keep the track of the details of their collected data on which certain interpretations or claims are based so that other researchers can investigate the data and confirm, adapt, or reject the existing

interpretations (Mackey and Gass, 2005: p.352). For this purpose, all the steps of this study were recorded in detail by using an audit trail method. All the modifications done in any step of this study were recorded and preserved in case they may be necessary for some further discussion. In order for other researchers to read and interpret the current study effectively, the results were supported by a number of resources like visuals regarding percentages and prevalent linguistic patterns and excerpts.

3.7. CONCLUSION

In this chapter, the methodological component of the current study is introduced. First of all, research design of the study is discussed. Secondly, detailed information regarding the institutions in which the data are collected is proposed. Followingly, the background of participant teachers is given. Then, data collection procedure is presented in detail. Concerning data analysis process, the method of data analysis, and the steps of data reduction, transcription and coding are revealed. As the last part, the ways of ensuring validity and reliability of the study are demonstrated.

CHAPTER 4

4. FINDINGS

4.1. INTRODUCTION

This chapter reveals findings of the study regarding the use of cognitive discourse functions in Turkish tertiary EMI context. Based on the construct suggested by Dalton-Puffer (2013, 2016) the distribution and their preliminary interpretations are presented in the first place. Initially, the general distribution of the CDFs is presented. Then, the distribution of each CDF based on different lectures is demonstrated. Then, the specific lexicogrammatical structures to realize those functions are investigated. As the next step, the realizers of the cognitive discourse functions in the observed lectures are examined. Lastly, the extent to which the learning outcomes of the observed lectures are met through the use of cognitive discourse functions is analyzed.

4.2. GENERAL DISTRIBUTION OF COGNITIVE DISCOURSE FUNCTIONS

The first research question sought to reveal the most common CDFs in the observed lectures. Accordingly, the results concerning the first research questions are presented in two consecutive sections (i.e., *general distribution of CDFs and distribution of CDFs based on individual lectures*).

Regarding the first research question, 1666 CDF were observed as for the general distribution of the CDFs across all observed lectures, which means that approximately one CDF was used every minute on average. The following figure shows the overall distribution of CDF types in percentages.

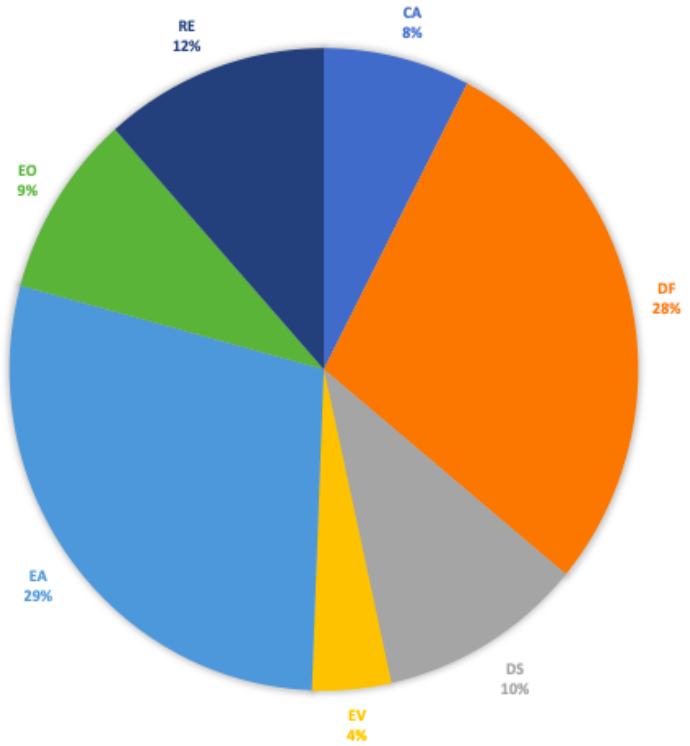

Figure 4. Distribution of CDFs types in all lessons

As can be seen, all the CDFs suggested by Dalton-Puffer's (2013, 2016) construct were observed in all lessons. While the CDFs "Explain" and "Define" are the most observed ones in the collected corpus, "Evaluate (EV)" seems to be the least preferred CDF type. However, there are differences in frequencies when analyzing the lectures separately, which is investigated in detail in the following section. To gain a more detailed understanding of the general distribution of CDFs in the observed lessons, the number of CDF occurrences in all lessons and their frequencies are presented in the following tables.

Table 10. *Distribution of CDF types in all lectures*

CDFs	L1		L2		L3		L4		TOTAL	
	N	**F (%)**	**N**	**F (%)**	**N**	**F (%)**	**N**	**F (%)**	**N**	**F (%)**
CA	46	2,76	65	3,90	11	0,66	4	0,24	126	7,52
DF	169	10,14	105	6,30	177	10,62	23	1,38	474	28,4
DS	46	2,76	74	4,44	52	3,12	4	0,24	176	10,51
EV	17	1,02	27	1,62	13	0,78	11	0,66	68	4,04
EA	212	12,72	83	4,98	149	8,94	32	1,91	476	28,52
EO	36	2,16	10	0,60	107	6,42	1	0,060	154	9,2
RE	63	3,78	57	3,42	41	2,46	31	1,92	192	11,54
TOTAL	589	35,35	421	25,27	550	33,01	106	6,42	1666	100

Table 10 shows individual and total occurrences of CDFs in the observed lectures. It does not show the ratio regarding the number of CDFs used in each lesson, which is examined in the following section. Therefore, Table 10 is about the interpretation of the total corpus, not individual lectures. Firstly, it should be noted that the occurrences and frequencies of CDFs in dynamics lecture, labelled as L3, seems lower than others. This is due to the fact that the duration of observation for this lecture is shorter than others. 2 lectures which lasted 157 minutes were observed and analyzed within the framework of this study.

As can be seen, “Explain” and “Define” are the most common CDF types across four different courses. All these courses are science courses in which technical terms are defined and formulas or problems are explained. That can be the reason why these two functions outnumber compared to others.

The functions “Report” and “Describe” are the second most observed ones in the general corpus. The utterances intended for narrating, presenting research or experiment findings, talking about facts, summarizing the topics, and referring to a previous utterance are regarded as reporting in this study as suggested by Dalton-Puffer (2016: p.49)

As for descriptions, they were given after a certain concept had been defined or introduced. They were done in the forms of physical, structural, functional and process descriptions. The distribution and frequency of each description type based on the total descriptions is shown in the following tables.

Table 11. *Distribution of description types based on total descriptions*

Description Types	L1		L2		L3		L4		TOTAL	
	N	**F (%)**	**N**	**F (%)**	**N**	**F (%)**	**N**	**F (%)**	**N**	**F (%)**
Physical	16	9,09	21	11,93	12	6,81	4	0	49	27,84
Structural	10	5,68	18	10,22	6	3,04	23	2,27	38	21,5
Functional	7	3,97	14	7,95	4	2,27	4	0	25	14,2
Process	13	7,03	21	11,93	30	17,04	11	0	64	36,36
TOTAL	46	26,13	74	42,04	52	29,54	32	12,27	176	100

Referring to the Table 11, it can be stated that process descriptions occupied the biggest place in all descriptions. In chemistry classes, there were a number of chemical reactions needed to be described. How those reactions took place was generally described in the form of process descriptions. Similarly, in physics classes, the teacher constantly asked and answered questions regarding moving and crashing objects which were delivered through process descriptions while talking about the concepts of velocity and friction.

"Explore" is the fifth most used CDF in the observed lessons. This function was generally preferred while teachers were trying students to think further. For example, the teachers formed sentences like "What would happen if…?" to stimulate students to think about the possible results of chemical reactions. The reason why the CDF "Explore" has the biggest ratio in the physics classes is that the teacher tended to create spontaneous questions or scenarios by using phrases like "Let's say" and "Let's assume", which is investigated with examples in the following sections.

After "Explore", the CDF "Categorize" is the sixth most observed type. In general, the categorizations were done based on comparisons among things, giving a specific example of a broader concept and talking about the belonging of something to a certain category. Dalton-Puffer (2016) states that coming up with relevant features between a specific example and the broader concept is important while classifying or categorizing (p.34). In this regard, comparisons were important because they helped students distinguish between terms which belonged to different categories.

Lastly, the CDF "Evaluate" is the least used CDF across all the lectures. It is probably because of the fact that all of these lessons are based on pure science, which reduces personal judgements. The occasions in which the CDF "Evaluate" was used generally included lecturers' desire to give advice about a certain method or emphasize the importance of a point. Therefore, rather than behaving subjectively, the lecturers tried to open new pathways to students in terms of grasping content better and reaching conclusions more easily.

4.2.1. Metatalk

Apart from CDFs, another category called "Metatalk" is added which emerged during the data analysis process. "Metatalk" is not a CDF, and it was calculated separately from other CDF, therefore this category did not affect the distribution of other CDF types. For physics class, there were a number of examples regarding the use of metatalk, especially while giving definitions. Therefore, I presented the findings for this category as for my personal interest.

Table 12. *Distribution of "Metatalk" based on total number of coding*

Metatalk	L1		L2		L3		L4		TOTAL	
	N	F (%)	N	F (%)	N	F (%)	N	F (%)	N	F (%)
	6	0,36	5	0,30	53	3,18	1	0,60	65	3,9

There are only three examples of the use of metatalk regarding "Explain" and one for "Describe". When the teachers tried to introduce or define the term, they sometimes used the exact verb "Define" to signal they would give a definition. As far as my field notes concerned, most of the students took up their pencils and tried to note down what teachers said when they did this. Therefore, the use of metatalk while giving definitions performed as an attention-grabbing tool in this sense.

4.2.2. Complex CDFs

During the data analysis process, some utterances in which more than one type of CDF was used were observed. These sentences were labelled as "Complex Cognitive Discourse Functions" as Breeze and Dafouz suggested (2017: p.88). They state that the use of complex CDFs is linguistically more demanding compared to a single CDF as two different cognitive functions are activated simultaneously when complex CDFs are used (p.88). The complex CDFs occurred in the observed lectures are shown in the following table.

Table 13. *Distribution of complex CDF across observed lectures*

Complex CDF Type	L1 General Chemistry-Departmental)	L2 General Chemistry-Across disciplines)	L3 (Physics)	L4 (Dynamics)	TOTAL
Explore + Explain	1	0	10	0	11
Define + Categorize	0	1	0	0	1
Define + Explain	0	1	9	0	10
Describe + Explain	0	1	2	0	3
Categorize + Explain	2	3	1	0	6
Define + Describe	0	2	2	0	4
Evaluate + Explain	4	9	5	2	19
TOTAL	8	17	28	2	52

In total, 52 instances regarding the use of complex CDFs were observed. These complex CDFs were also separately evaluated from other individual CDF in order not to confuse the results. Besides, no frequency was given for this category because the ratios are too low to reach a common pattern. Therefore, only a number of occasions with complex CDFs are presented.

L3 was the physics lecture in which the highest number of complex CDF was used. Most of the complex CDFs used in that lecture was “Explore + Explain”. There were three examples of the use of “Classify + Explain” in the general chemistry (across disciplines) class. However, there were not many occasions in which complex CDFs were used in L1, which is the departmental general chemistry lecture. Most of the CDFs used in that lesson were single. On the other hand, no

complex CDFs were detected in L3, which is the dynamics lecture, because the total duration of that course was relatively shorter than others and that lesson was generally based on problem solving activities. The following excerpts show the actual usages of complex CDFs across three lectures.

Excerpt 1
Example 1 of the complex CDF "Evaluate + Explain"

80	T1	And also, these valence electrons are *important because* those are the ones that enter into the reaction.

"Evaluate + Explain" was found to be the most prevalent complex CDF observed in the lectures. In Excerpt 1, T1 firstly realized the function "Evaluate" with the adjective "important". Then, she added a subordinate clause by using the subordinate conjunction "Because" to explain the reason why it was important.

Excerpt 2
Example 2 of the complex CDF "Evaluate + Explain"

33	T3	If there is a conservative force, you can derive a potential energy. You can derive... *Be careful with the spelling of 'derive' because* 'derive' and 'drive' are spelled differently, you know.

In Excerpt 2, T3 warned the students about being careful about the words "Derive" and "Drive" because he thought that it would be difficult for students to differentiate between their pronunciations. Since this occasion showed the teacher's personal opinion about the issue, it was regarded as an evaluation. Its combination with the subordinate conjunction "Because" made it a complex CDF.

Excerpt 3
Example 3 of the complex CDF "Evaluate + Explain"

26	T2	Look at this. *This is not quite important because* there is a larger charge separation.

Excerpt 3 is another example of the complex CDF "Evaluate + Explain" observed in L2. T2 firstly made a personal judgment about the importance of the issue. Then, he explained the logic behind his judgment.

Excerpt 4
Example 1 of the complex CDF "Explore + Explain"

123	T1	So, it has empty D orbitals as well so it can expand its octet. So, this one will be an expanded octet and the correct Lewis structure is like this. You *might* think shift these electrons to here *because* this one can have expanded octet.

"Explore + Explain" was the second most common on the complex CDF in general corpus. In excerpt 4, T1 made an assumption about the way the students think about the result of a chemical activity by using the modal verb "Might". Dalton-Puffer (2016) states that the use of modal verbs is one of the ways to realize the CDF "Explore" (p.47). Then, T1 connected a subordinate clause with "Because" to state a causal relationship, as the realization of the CDF "Explain". Therefore, this utterance combines both "Explore" and "Explain", which makes a complex CDF.

Excerpt 5
Example 2 of the complex CDF "Explore + Explain"

30	T3	You can *assume* that this is DT. You can *assume* that this is DT. You can *assume* that R is constant from here to here *because* D theta has a very very small change in the angular position.

In Excerpt 5, T3 encouraged students to make an assumption and he explained the logic behind this assumption with the CDF "Explain", which makes the whole utterance an example of the complex CDF "Explore + Explain".

Excerpt 6
Example 1 of the complex CDF "Define + Explain"

20	T3	This is about mass, *that's why* indeed *it is called* mass moment of inertia - mass moment of inertia, *so, that's why* it is one over two pi omega squares.

In Excerpt 6, T3 was talking about the visualization of a physical formula on the board. Then he introduced a result clause by using the phrase "That is why" and connected it with the definition of the term "Mass moment of inertia" with the phrase "It is called". Followingly, he inserted another result clause with the phrases "So"

and “That is why” to explain the consequence. Thus, he mixed both “Define” and “Explain” in the same utterance.

Excerpt 7
Example 1 of the complex CDF “Categorize + Explain”

21	T2	*Compare* the nitrogen and oxygen, nitrogen is *much more stable than* the oxygen. *That’s the reason why* we have the second peak here.

Excerpt 8
Example 2 of the complex CDF “Categorize + Explain”

176	T3	*Compare* these two works. Are they, are they equal to each other? No, *that means the force* of kinetic friction is not conservative.

“Classify + Explain” was another complex CDF which was observed in three courses. As suggested by Doiz and Lasagabaster (2021), comparisons were evaluated under the title of “Categorize” because comparisons are about dinding out relevant patterns (p.60). By this way, their belonging to a broader concept can be determined. In the general chemistry lesson, T2 compared nitrogen and hydrogen in terms of their stability, which signals their place in the periodic table. Then, he added a result clause to explain the reason why there exists a peak in the visual that he showed on the board. In the physics lesson, T3 explained why kinetic friction is not conservative by comparing two works in terms of their inequality to each other.

Excerpt 9
Example 1 of the complex CDF “Define + Classify”

3	T2	And *these are* the elements that exist 20 degrees in 1 atmospheric pressure *(Showing on the board)* like nitrogen, oxygen fluorine, and chlorine.

In this excerpt, T2 introduced the elements referring to the board in the first place. Then, he gave certain examples belonging to that category. Therefore, he both made a definition and categorization, which required the use of a complex CDF “Define + Classify”.

Excerpt 10
Example 1 of the complex CDF "Define + Describe"

10	T3	This *is the reduction of the path,* and *it is perpendicular to that one*. So, the direction of the velocity is always in the tangential axis.

As the last example of the use of complex CDF in the observed lessons, Excerpt 10 shows an occasion of the use of "Define + Describe". In this physics lecture, T3 firstly introduced a concept called reduction of the path by showing it on the board. Then, he made a physical description about the introduced term.

4.2.3. Translations (coded as Define + Translate)

Even though they are not regarded as CDFs, there were a few examples of translations while defining a concept or term. These occasions were labelled as "Define + Translate" which are presented in the following table.

Table 14. *Distribution of the function "Define + Translate" across the lectures*

	L1	L2	L3	L4
Define + Translate	2	0	5	0

As can be seen, there are only seven examples of "Define + Translate" throughout the whole corpus. This is mostly because of the fact that all of the participant teachers strictly adhered to the tenets of EMI and avoided speaking in their mother tongue as far as possible. Besides, almost all those occasions were realized through teacher-student interactions. While the teachers were trying to define a term, students uttered the Turkish translation of those terms, which was labelled as "Define + Translate". Therefore, the part "Translate" was based on students' Turkish utterances. The following excerpts show the occasions in which "Define + Translate" was used.

Excerpt 11
Example 1 of the use of "Define + Translate" in the departmental general chemistry course

115	T1	So, diethyl ether is volatile. *Volatile?*
116	S1	*Uçucu* [TR].

Excerpt 12
Example 2 of the use of "Define + Translate" in the departmental general chemistry course

214	T1	But this time, the pi bond formation is not confined to 2 carbon atoms, but rather they will form something cycling. We call such bondings delocalized bonds. *What is local?*
215	Ss	*Yerel* [TR].

These are the examples of "Define + Translate" episodes in the departmental general chemistry course. T1 generally tended to define each term in detail in the framework of the CDF "Define" rather than asking the terms to the students. When they were supposed to give definitions or explanations, students were mostly speaking in their mother tongue, which was Turkish. The teacher was aware of this. That was the reason why she avoided asking specific terms to students because she knew that students would answer in Turkish. Rather, she was asking questions about the numerical results and the name of the chemical compounds. On such occasions, students were using at least the English counterparts of chemical compounds while answering.

Excerpt 13
Example 1 of the use of "Define + Translate" in the physics lecture

82	T3	Mass moment of inertia, it is a kind of physical quantity related to inertia, because mass is a physical quantity that resists acceleration. Inertia... *What is inertia, in Turkish?*
83	Ss	*Eylemsizlik* [TR].

Excerpt 14
Example 2 of the use of "Define + Translate" in the physics lecture

52	T3	*(Showing on the board)* These four are fastened. *What's fastened?*
53	S24	*Bağlamak* [TR].

Excerpt 15
Example 3 of the use of "Define + Translate" in the physics lecture

20	T3	Let's take a solid object. *What is a solid object?*
21	S9	*Katı* [TR)..
22	T3	It is an object that does not deform, okay? It is a very firm object.

Just like T1, T3 also refrained from asking specific definitions to students because students in that class were speaking in their mother tongue all the time. There were only four examples in which "Define + Translate" was used. All of those occasions were similar. Therefore, these two excerpts were chosen as representatives. As can be seen from Excerpts 14 and 15, when students were asked a question starting with "What is...?" they tended to answer in Turkish translation of the term. This was also the case for Excerpt 13, but T3 intentionally wanted the Turkish equivalent of the term on that occasion. For Excerpt 15, T3 first directly asked the definition of a solid object and the students responded in Turkish. Then, T3 gave his own definition in English by referring to the student's Turkish contribution.

4.3. DISTRIBUTION OF COGNITIVE DISCOURSE FUNCTIONS BASED ON INDIVIDUAL LECTURES

The distribution of CDFs in each lecture is investigated separately regarding the first research question in this section. The use of each CDF differs in different lectures. The following table demonstrates the distribution CDFs in each lecture.

Table 15. *Distribution of CDFs based on individual courses*

CDF	L1 (General Chemistry-Departmental)	L2 (General Chemistry-Across Disciplines)	L3 (Physics)	L4 (Dynamics)
CA	7,80%	15,43%	2%	3,73%
DF	28,69%	24,94%	32,1%	21,49%
DS	7,80%	17,57%	9,45%	3,73%
EV	2,88%	6,41%	2,36%	10,28%
EA	35,99%	19,71%	27,09%	29,90%
EO	6,11%	2,37%	19,45%	0,93%
RE	10,69%	13,53%	7,4%	29,90%
TOTAL	100%	100%	100%	100%

As can be seen, the CDFs “Define” and “Explain” seem to be the most frequent types in all lectures. However, the former is the most observed one in L2 and L3, while the latter is the most observed one in L1 and L4.

4.3.1 General Chemistry I / L1 (Departmental)

The departmental general chemistry course, labelled as L1, was designed only for chemistry students as opposed to L2, which is for students from different disciplines. The following figure shows the distribution of each CDF used in L1.

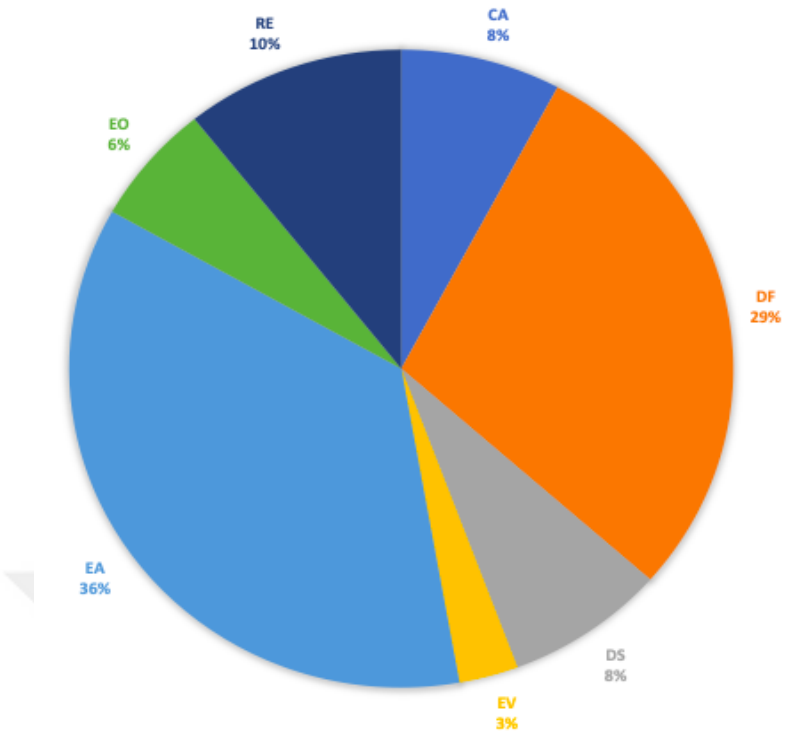

Figure 5. Distribution of CDF types in L1

The fact that this course was a departmental one can be the reason why the CDF "Explain" was observed higher than other functions. Students who were registered to L1 were the ones studying at the chemistry department. They were supposed to gain a deeper insight about the causal relationships regarding the content, so they were given more detailed content as opposed to L2, in which the content was not designed for chemistry students but for students coming from different departments.

The CDF" Define" was the second most observed one in L1 because terminological expressions occupied a huge place in the content of L1 as far as my observations and field notes concerned. There were a number of terms to be introduced regarding kinds of reactions and chemical compounds which were delivered through the use of the CDF "Define". Correspondingly, a number of different realizations of the CDF "Define" were observed, which is examined in detail in the following sections. Besides, some of the definitions were given through the use of blackboard and slides which was also observed in Doiz and Lasagabaster's study (2021: p.65). T1 sometimes drew the shape or structures of the chemical

compounds on the blackboard or showed them from the slides to give definitions. These kinds of definitions did not occupy a big place compared to total numbers of definitions. Out of 169 definitions, 32 of them were done through the blackboard or slides. However, they were important because when they saw the figure or visual of the things which were defined, I observed that they were drawing the shapes on their notebooks, which could be contributing to their comprehension. Besides, T1 also brought the 3D models of chemical compounds to the classroom to introduce and define the shapes of them, which also played a significant role in terms of content delivery. They asked less comprehension questions which required clarification by the teacher as they seemed to grasp the topic better when they were exposed to visual materials.

The CDF "Report" was found to be the third most observed one in L1. This function was mostly detected while T1 was referring to a previous utterance or point and summarizing at the end of the lectures. Additionally, there were occasions in which T1 talked about scientific facts or findings of some studies and experiments, which were also coded as "Report".

The CDF "Categorize" and "Describe" were observed equally in L1. "Categorize" were mostly recorded while T1 was talking about comparisons or giving examples for a general category. For descriptions, each type of description was observed in L1. The following figure shows the distribution of description types in L1.

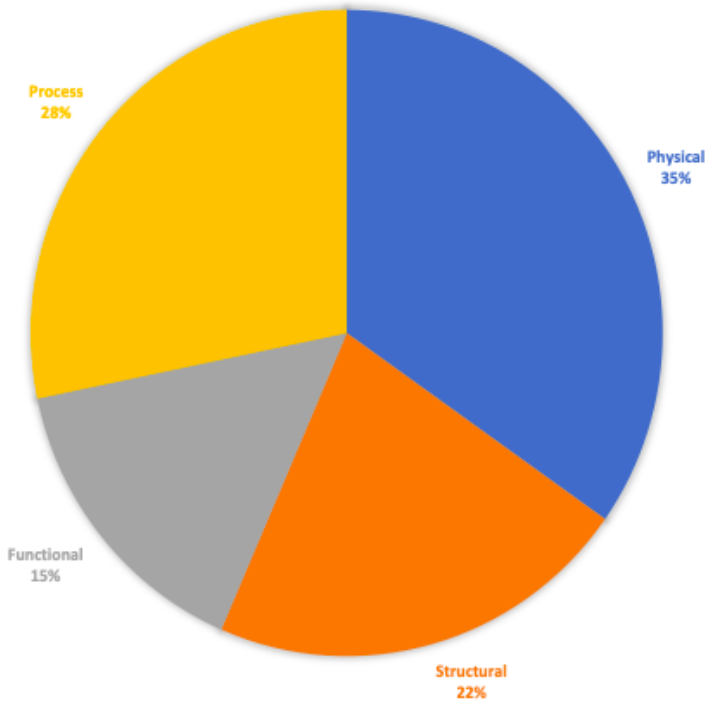

Figure 6. Distribution of description types in L1

As can be seen, physical descriptions occupy the biggest place in L1. Out of 46 descriptions, 16 of them were physical. While talking about the placement of elements in chemical compounds, T1 mostly used physical descriptions together with structural ones because she could tell the properties of those compounds through structural descriptions, which were observed 10 times. Having been observed 13 times, process descriptions were used to tell the phases of a chemical reaction. The least observed ones were functional descriptions, which were observed 7 times. They were mostly detected while talking about the usage areas of chemical compounds or reactions.

"Explore" was the sixth most observed CDF type in L1. Sometimes, T1 tried to encourage students to imagine possible results or situations when particular conditions were met. These kinds of utterances were coded as the CDF "Explore".

Lastly, the CDF "Evaluate" was found to be the least used CDF in L1. It was observed that T1 mostly avoided giving personal judgments or opinions throughout

her lessons. The occasions in which the CDF "Explore" was observed were mostly based on emphasizing the importance of a point during lesson.

4.3.2. General Chemistry I / L2 (Across disciplines)

The general chemistry lecture, labelled as L2, was offered for students from different departments contrary to L1, which was only designed for students studying at the department of chemistry. Therefore, there were differences in terms of content between the two lectures. While the content in L1 was more detailed and loaded, L2 was based on a broader topic spectrum as far as I observed. The overall distribution of CDFs in L2 is shown in the following figure.

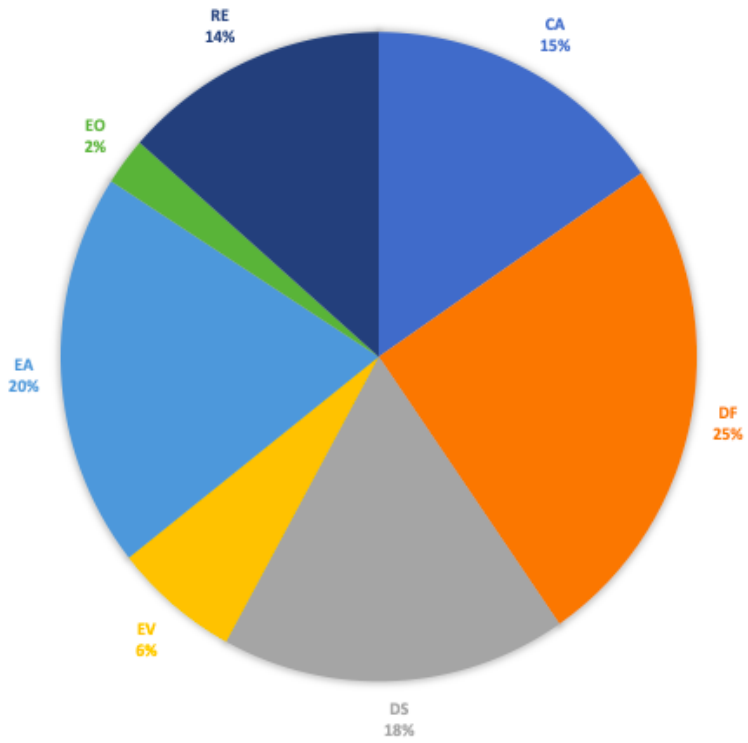

Figure 7. Distribution of CDF types in L2

In this lecture, the CDF "Define" is the most prevalent one when compared to L1. Just like L1, blackboards or slides were also used in some definitions in L2. Out of 105 definitions, 34 of them were delivered through the help of the blackboard or slides. Therefore, it can be stated that one third of the total definitions in L2 were done in this way. T2 usually used the blackboard to draw structures of chemical

compounds or atomic orbitals which he defined. As far as my observations concerned, students tended to note down what they saw when they were given visual definitions just like it happened in L1.

The CDF "Explain" was the second most frequent type, constituting one fifth of the total number of coding in L2. Utterances which included causal relationships or result statements were coded under the title of the CDF "Explain". This CDF was also realized through a range of different linguistic structures. Those structures are investigated in detail in the following section.

The CDF "Describe" was the next most observed type in L1. Each type of description was detected throughout L2. T2 mostly used descriptions to talk about the physical arrangement, shapes, and structure of chemical compounds. Process and functional descriptions were detected as well. The following figure summarizes the distribution of description types in L2.

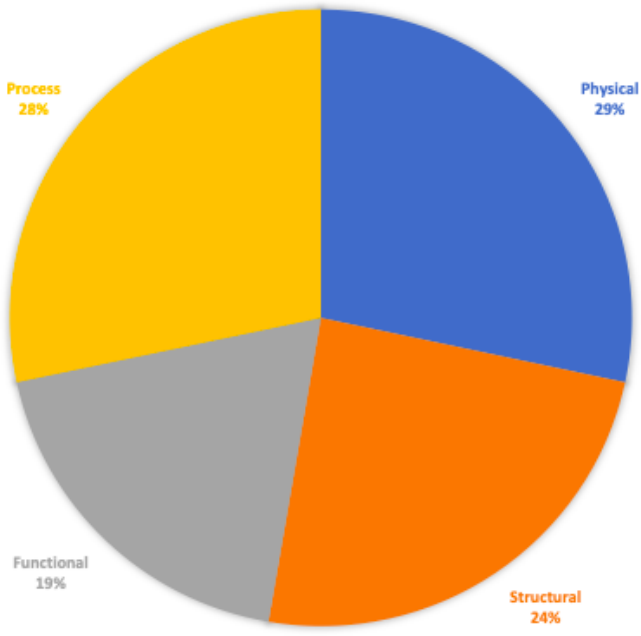

Figure 8. Distribution of description types in L2.

Based on the Figure 8, it can be stated that physical and process descriptions were observed equally in L2. While talking about the steps of a chemical reaction, T2 generally used process descriptions. Having been observed 21 times, they were also used during the processes of solving examples and dealing with practice questions. Just like it happened in L1, the physical statement of chemical compounds and the placement of atoms in atomic orbitals were examined under the title of "Physical description". Similarly, the occasions in which T2 was talking about the inner mechanism of something were labelled as "Structural description". Lastly, utterances regarding the functions and capabilities of something were coded as "Functional description".

The distribution of the CDFs "Report" and "Categorize" were found to be close to each other. There were some occasions when T2 talked about the research or experiment findings which were coded as "Report". Categorizations were mostly done based on comparisons and groupings of chemical elements.

Unlike L1, the CDF "Evaluate" was not the least observed one. Nonetheless, rather than giving personal judgments, T2 used the CDF "Evaluate" to highlight important steps of reactions and significant points during the flow of the lecture.

The CDF "Explore" was the least observed type in L1. It was observed only 10 times throughout the 6 weeks of observation. T2 did not prefer to talk about the possible scenarios based on the potential realization of some situations as opposed to T1.

4.3.3. Physics / L3

The physics lecture was designed for students studying in the Mechanical Engineering Department. Unlike L1 and L2, partial EMI program (i.e., 30% English) was provided for the students registered for this class. Therefore, none of the students' contributions were English in both physics (L3) and dynamics (L4) classes. The following figure shows the distribution of CDF types in L3.

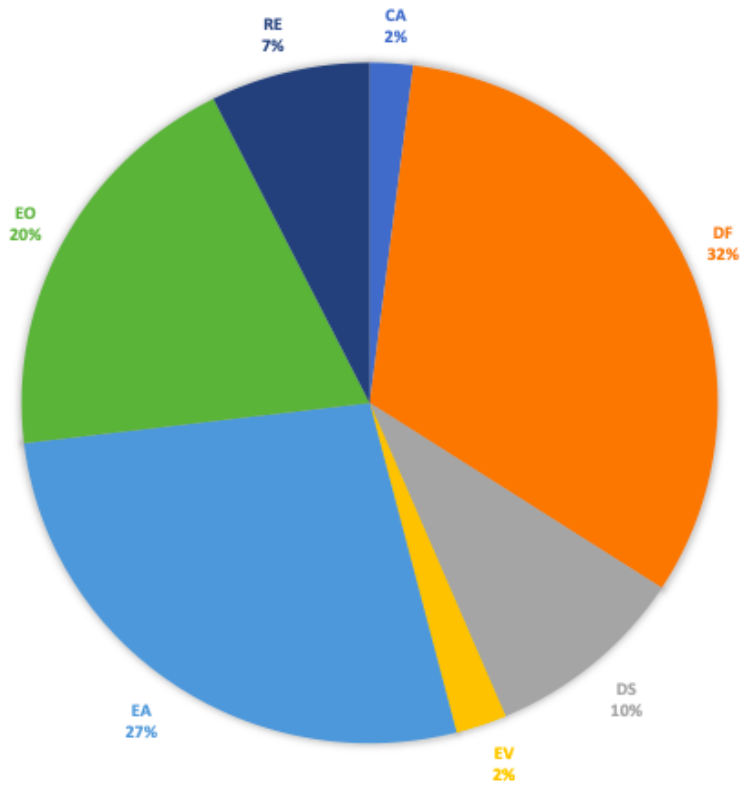

Figure 9. Distribution of CDF types in L3

As can be seen, there are many differences between chemistry lessons and this physics lesson in terms of the use of the CDFs. The most observed CDF type in L3 was “Define”. There were a bunch of new terms to be introduced to the students in the scope of this lesson. T3 both benefited from the blackboard and slides while giving definitions. Out of 177 definitions, 35 of them were done through the use of the blackboard or slides. Therefore, it can be said that more than one third of the total definitions in L3 were given in this way. T3 generally drew the shapes and wrote formulas on the board and then, he introduced the parts of the shapes and the elements of the formula referring to the board while giving definitions.

The CDF “Define” was followed by “Explain”. Explanations were also mostly observed through L3. Most of the explanations were made while solving problems in which T3 explained the reasons why a physical formula was needed to

be applied. A detailed representation of the linguistic structures to realize the CDF "Explain" is given in the following section.

As an interesting finding, the CDF "Explore" was found to be the third most prevalent one in L3 as opposed to L1 and L2. In this lecture, T3 tended to form utterances to create possible questions or scenarios to motivate the students to think further. While doing this, he mostly used the phrase "Let's say" which was labelled as "Explore" because the function of that phrase was about assumptions or imaginations about certain situations in which the introduced physical equation could be used.

As for descriptions, all the types of descriptions were also observed in L3, which is shown in the following figure.

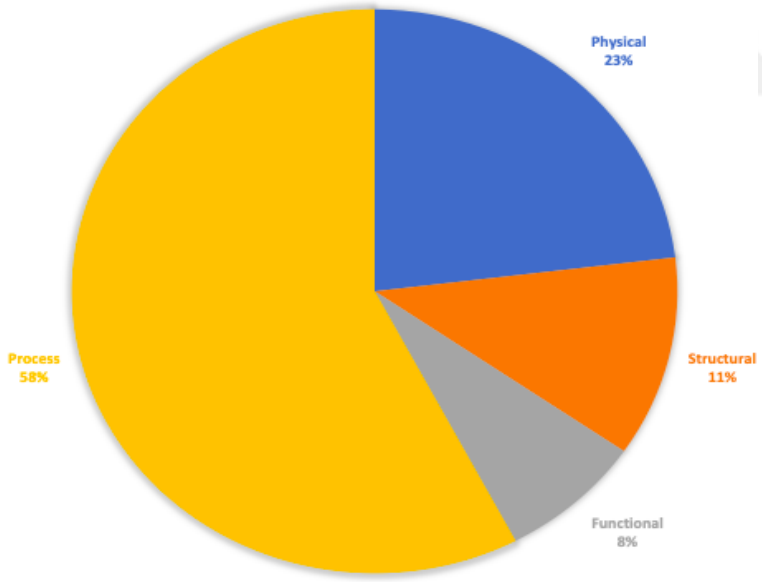

Figure 10. Distribution of description types in L3

As can be seen in Figure 9, process descriptions have the biggest portion in the total descriptions. Out of 52 descriptions, 30 of them were process descriptions. This is because of the fact that there were a number of occasions in which the movement of the objects were told while delivering the topics of friction and

velocity. There were a range of examples regarding car crashes, fired guns and falling objects which required detailed process descriptions by the T3. Physical descriptions were also observed in L3. T3 talked about the inclines on some graphics and used physical descriptions to give details about them. Structural and functional descriptions were observed less than the others.

The second most observed CDF type was “Report” in L3. T3 mostly used this type while talking about the rules of physics and summarizing the main points during lectures.

The CDFs “Categorize” and “Evaluate” were found to be the least observed ones. Categorizations were mostly done while talking about the kinds of some physical forces and giving examples. Out of 550 CDF observed in L3, only 13 of them were the examples of the CDF “Evaluate”. The occasions in which this function was observed were mostly about emphasizing the crucial points just like L1 and L2.

4.3.4. Dynamics / L4

The Dynamics lecture, which was named as L4 in the scope of this study, was designed for students studying in the Mechanical Engineering Department just like L3. This lecture was also delivered by T3. However, when compared to the length of the recording of the previous three lectures, the observation and recording of this course were shorter. Therefore, 106 CDFs were observed in total throughout L4. The observation of this course was important in terms of supporting the findings of the T3’s language use. The overall distribution of the CDFs observed in L4 is shown in the following figure.

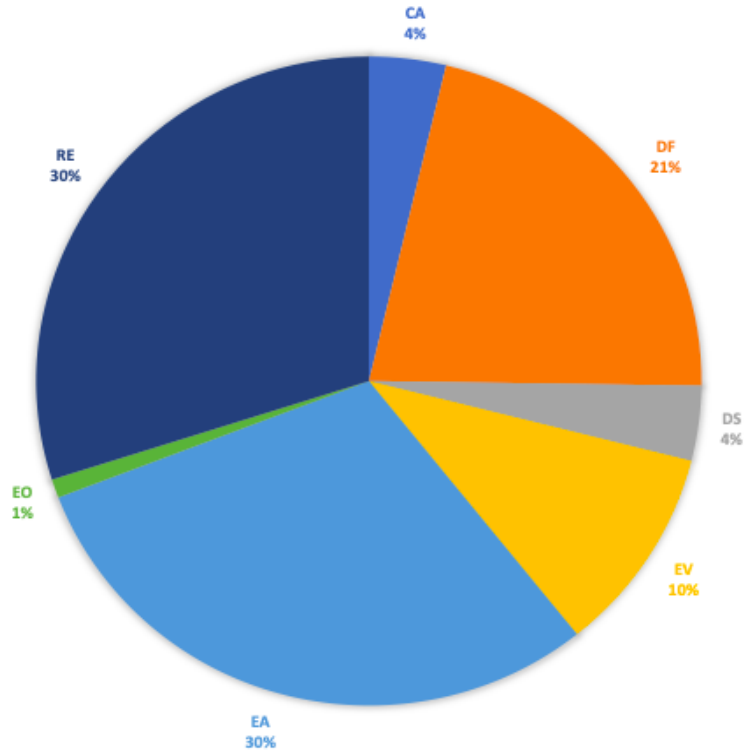

Figure 11. Distribution of CDF types in L4

In the scope of this lecture, the most observed CDF types were “Explain” and “Report”. The function “Report” was realized through T3’s utterances about facts or research results, references to the previously said utterances and reviews about the topics. There were also statements about the tenets of physical rules which were regarded as the CDF “Report”. Explanations were generally based on solutions of problems. T3 firstly introduced the practice questions. Then, he gave detailed explanations while answering by expressing the causes and results.

The CDF “Define” was the following most occurring type in L4. Just like it happened in L3, a number of terms needed to be defined while giving physical equations. T3 sometimes supported his definitions through the use of the blackboard and slides. Out of 23 definitions, six of them were given through the use of the blackboard and slides, which constitutes more than one fourth of the total definitions observed in L4.

The CDF “Evaluate” was the fourth most used type in L4. Having been observed 11 times, this CDF occurred when T3 tried to emphasize the significance of a topic or wanted to warn the students about some important points.

The CDFs “Describe” and “Categorize” were observed four times in L4. As for descriptions, only structural descriptions were detected due to the short length of the observations and recordings. As there were only four structural descriptions throughout the whole observations, no chart is given regarding them.

The least observed CDF type was “Explore” with only one instance throughout the dynamics lecture. There were also utterances including the phrase “Let’s say” just like in L3. However, the function of those phrases was not “Explore”. Instead, they were used as fillers in this lesson. The function of the phrase “Let’s say” is investigated in detail in the following section.

4.4. LINGUISTIC MANIFESTATIONS OF COGNITIVE DISCOURSE FUNCTIONS

Regarding the second research question, the linguistic manifestations used to realize CDFs in the observed lectures are investigated. Correspondingly, several patterns concerning common linguistic structures to perform CDF types were found and presented through tables and visuals.

4.4.1. The CDF “Categorize”

Three different linguistic patterns were detected in terms of the realization of the CDF “Categorize” throughout all observed lectures. These are namely the use of comparatives and adjectives (e.g., *similar* and *different*), the phrases “type(s)/ kind(s) / example(s) of”, and particular performative verbs (e.g., *group, classify* and *compare*). The frequencies and linguistic realizations of the CDF “Categorize” are examined in detail in the following sections.

4.4.1.1. The linguistic structures used to realize the CDF “Categorize” in L1

As one of the least occurring CDF types in L1, “Categorize " was observed 46 times throughout L1. The following figure summarizes the distribution of the linguistic structures to realize the CDF “Categorize” in L1.

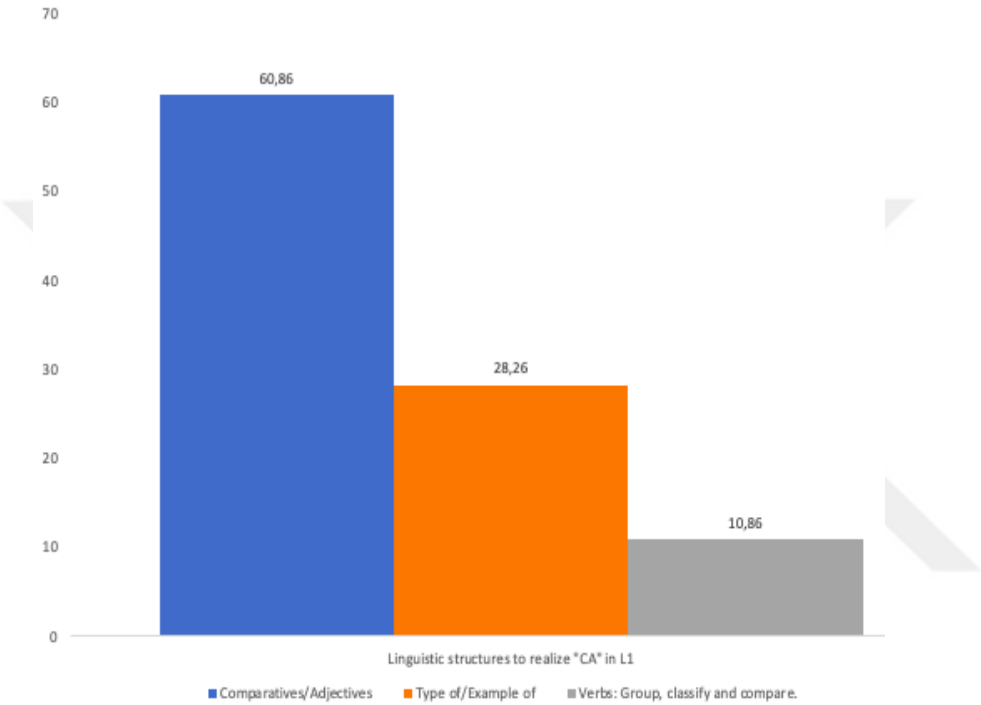

Figure 12. Distribution of the linguistic structures to realize the CDF “Categorize” in L1

The majority of the CDF “Categorize” was realized through the use of comparatives and adjectives. Comparisons were important in terms of grouping elements based on their shared properties as Doiz and Lasagabaster (2021) stated (p.60). To compare two things, the structure “as + adjective + as” was preferred, too. Examples and mentioning the types of a broader concept were also evaluated as categorizing. Lastly, categorizations were done through the use of certain performative verbs. Examples regarding all those usages are shown in the following excerpts.

Excerpt 16
Example 1 of a categorization through comparisons in L1

444	T1	In this temperature, because you convert it to a gaseous form substance, intermolecular forces in water molecules are quite strong *whereas* this one is already escaped from those intermolecular forces, converted into gaseous form, so this intermolecular force is probably *weaker* than this one.

Excerpt 17
Example 2 of a categorization through comparisons in L1

110	T1	And, as you see, the transition metals…Their radius is somewhat *similar*. They do not display many irregularities as the representative elements.

Comparisons and the use of adjectives like "similar" and "different" occupied the biggest place in the realization of the CDF "Categorize" in L1. Comparisons were generally based on the shared or distinguishing features of two things in order to determine whether they belong to the same broader category or not.

Excerpt 18
Example 3 of a categorization through comparisons in L1

431	T1	They are very compressible, because of the presence of these very large spaces between gas molecules, and they move randomly (..), freely because they do not attract or repel each other, there are very huge spaces between these, *whereas* the story for liquids and solids is quite *different*. In liquid, molecules are close to each other so that they are not *as compressible as* gas molecules. They are only slightly compressible.

In Excerpts 16 and 18, the notion of difference is also supported by the use of the conjunction "whereas", which strengthens the realization of the CDF "Categorize".

Excerpt 19
Example 1 of a categorization through types and examples in L1

100	T1	For instance, for lithium, where is lithium in the periodic table?
101	S	1A.
102	T1	It is in 1a. So, what *type of* ion does it tend to form?
103	S	Cation.

Excerpt 20
Example 2 of a categorization through types and examples in L1

498	T1	So, there are two *types* of chemical bonds.? What are they?
499	Ss	Ionic.
500	T	Ionic and covalent.

Talking about the types or examples of a concept was also prevalent in terms of the realization of the CDF "Categorize" in L1. Excerpts 19 and 20 are among the occasions in which T1 talked about types of ions and bonds regarding the realization of the CDF "Categorize".

Excerpt 21
Example 3 of a categorization through types and examples in L1

87	T1	Glass is an *example* for this one so here you see how these two forms are different from each other.

Excerpt 21 is about giving an example of a broader category, which is one of the linguistic manifestations of the CDF "Categorize".

Excerpt 22
Example 1 of a categorization through certain performative verbs in L1

4	T1	What is this periodic table based on? This is the *classification* of these elements, right? We *group* these elements with respect to their property.

Excerpt 23
Example 2 of a categorization through certain performative verbs in L1

534	T1	Let's *compare* the properties of covalent and ionic bonds because their physical properties differ significantly.

The last structure preferred to realize the CDF “Categorize” in L1 was using certain performative verbs like “Classify”, “Compare” and “Group”. By using these verbs, the teacher talked about the certain properties or shared features of things that could be listed under a certain broader category. For example, T1 used the verb “Compare” in Excerpt 23. Then, she stated that there are differences between covalent and ionic bonds with respect to their physical properties so that students could differentiate between the bonds that they encountered.

4.4.1.2. The linguistic structures used to realize the CDF “Categorize” in L2

The number of occasions in which the CDF “Categorize” was observed was 65 out of 412 CDFs in L2. The general tendency regarding the linguistic preferences to realize the CDF “Categorize” was found to be different from L1. The following figure shows the general distribution of the linguistic manifestation of the function in L2.

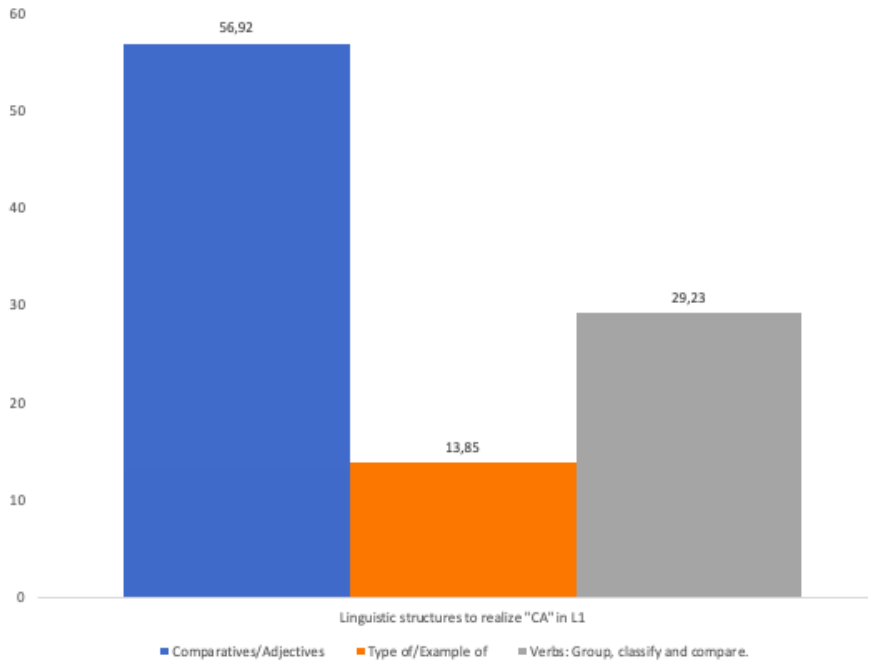

Figure 13. Distribution of the linguistic structures to realize the CDF “Categorize” in L2

Referring to Figure 13, it can be stated that the most observed linguistic pattern was again comparatives and adjectives in the realization of the CDF "Categorize" in L2. The following excerpts show how this CDF was actually realized through different linguistic manifestations in L2.

Excerpt 24
Example 1 of a categorization through comparisons in L2

14	T2	The middle nitrogen plus the charge of it and the negative charge makes the difference in negative charge of the oxygen atom and the negative charge of nitrogen atom. If you look at the periodic table, oxygen is *more electronegative than* nitrogen. Electronegativity means lost electrons at the high tendency.

Excerpt 25
Example 2 of a categorization through comparisons in L2

2	T2	Middle atom is Sulphur, and the lone pair is oxygen, and the geometry is bent. The tetrahedral arrangements... and the geometry...Like methane... Take the oxygen and lone pairs. The arrangement is the *same*, but the geometry is *different*. Triangular bipyramidal. Ammonia and the water molecules... The arrangement of the electrons is the *same*, but the geometry is bent.

The elements were categorized based on their electronegativity through the use of a comparison in excerpt 24. The comparison signals that oxygen and nitrogen belong to different classes in the periodic table. In Excerpt 25, it can be seen that various adjectives were used to categorize the chemical compounds with regard to their molecular shape. While ammonia and water molecules have a similar arrangement, their different geometry made them belong to different categories of chemical compounds, which was told through the use of adjectives.

Excerpt 26
Example 1 of a categorization through types and examples in L2

18	T2	We have 3 kinds of orbitals. The first *atomic orbitals* like S, P, and T, and we can generate the *hybrid orbitals* by using the *atomic orbitals*. Like SP2... This kind of stuff, and by using hybrid orbitals, we can construct *molecular orbitals.*

In Excerpt 26, it can be seen that T2 gave information about different kinds of orbitals which were atomic, hybrid and molecular, respectively. While doing this, T2 signaled the categorization through the phrase "3 kinds of orbitals".

Excerpt 27
Example 1 of a categorization through certain performative verbs in L2

6	T2	You have 2 electrons in the first subshell and 8 electrons in the second subshell and 5 electrons in the third subshell, and how should the elements be *classified*? (…) We cannot *classify* these elements by using just their atomic number. We do not know anything about them like... Whether this is metal, non-metal or metalates… We cannot answer this question.

In Excerpt 27, T2 asked students about the ways of classifying the elements shown on the board. He waited for an answer from the students for a couple of seconds. However, there was no answer regarding the classification of the elements that T2 asked. Then, T2 gave the answer by stating that there was not enough information to classify the elements properly.

4.4.1.3. The linguistic structures used to realize the CDF "Categorize" in L3

This CDF type was observed on a very few occasions throughout L3. This may be because of the fact that categorizations were not as necessary as they were in chemistry lectures. In chemistry lectures, the teachers needed to talk about chemical compounds that are similar or different from each other, which necessitated the CDF "Categorize" in those lectures. However, it was observed that the nature of the topics in the physics lecture were not dependent on the categorization of things or concepts. The following figure presents the linguistic realizations of the CDF "Categorize" in L3.

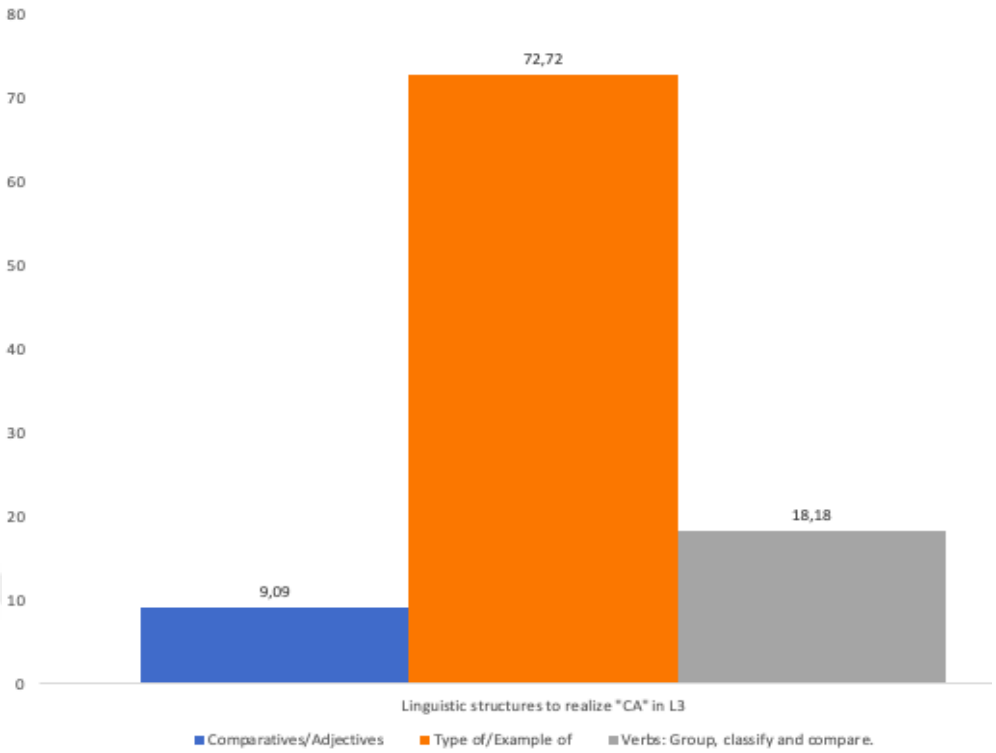

Figure 14. Distribution of the linguistic structures to realize the CDF "Categorize" in L3

Out of 550 total CDFs in L3, only 11 of them were "Categorize", which was the least observed CDF. The majority of categorizations in the physics lecture were based on types and examples. There were only two instances of the use of performative verbs and one instance of comparisons to make categorizations. The following excerpt illustrates the use of a categorization through types and examples in L3.

Excerpt 28
Example 1 of a categorization through types and examples in L3

51	T3	What *kind* of motion that the ball experiences? Hmm? You just hit the ball, okay? And then, it starts to fly, right? So, it has now, what *kind* of motion? (..) Projectile motion. Two-dimensional motion, right?

Just before this occasion, T3 talked about another concept called circular motion. Then, he asked the question "What kind of motion?" to raise students'

awareness regarding the different types of motions, which were circular and projectile motions.

4.4.1.4. The linguistic structures used to realize the CDF "Categorize" in L4

In the dynamics lecture, there were only four occasions in which the CDF "Categorize" was realized. Indeed, Physics and Dynamics classes have a lot in common, which may be the reason why the occurrences of categorizations were quite low in L4 just like L3. All of the categorizations in L4 were realized through the use of comparisons and adjectives like "similar" or "different". That is why a figure about the frequencies of the linguistic manifestations is not presented. The following excerpt shows an example of a categorization observed in L4.

Excerpt 29
Example 1 of a categorization through comparisons in L4

4	T3	This "T" … What is that? Torque force moment, right? It is very *similar* to the force. Force is M times A, and torque is F times L here. It is the mass moment of inertia, okay?

In this excerpt, T3 made a connection between *force* and *torque.* While force was used in the previous practice question during the lesson, torque was for the following one. As far as I observed, their functions were similar in both questions. Therefore, they could be handled in a similar way. That was why T3 emphasized their similarity for students to solve the problem more easily.

In general, three different structures were found to be used in the realization of the CDF "Categorize" in all lectures. The following figure shows the general distribution of those structures based on all lectures.

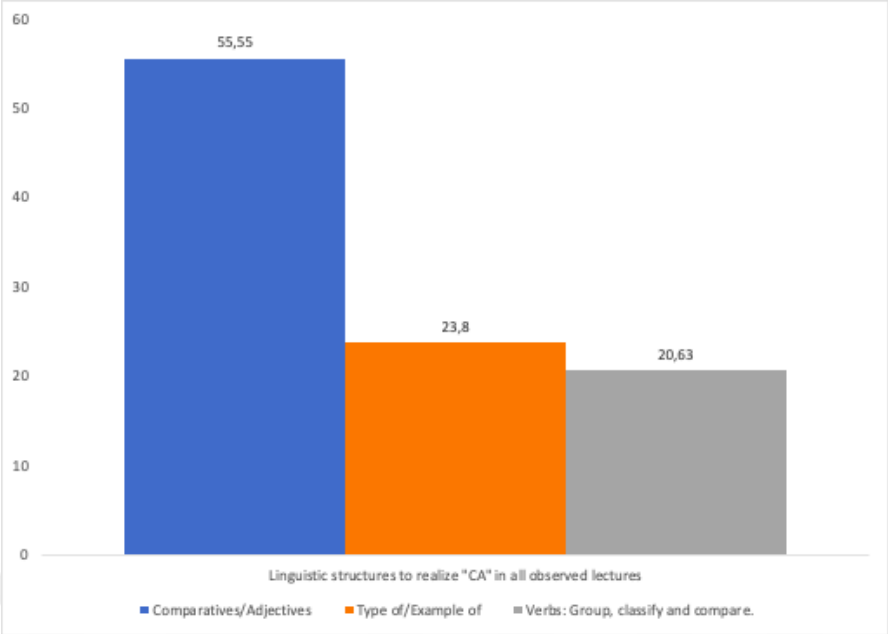

Figure 15. The general distribution of linguistic structures used to realize the CDF "Categorize" in all observed lectures

Referring to the Figure 15, it can be stated that comparatives and adjectives were found to be the most preferred structures in the realization of the CDF "Categorize" throughout all observed lectures. The distribution of the phrases "Type of/Example of..." and some performative verbs to categorize things were close to each other.

4.4.2. The CDF "Define"

The general tendency to realize this function in all of the observed lessons was based on the use of linguistic patterns like "This is X", "This is called/known as X", "This is X that has...", "X means/tells that..." and "The definition of X is...". Those realizations occurred in each lecture are examined individually in the following headings.

4.4.2.1. The linguistic structures used to realize the CDF “Define” in L1

The CDF “Define” was the second most occurring type in L1. It was found out that definitions were done based on four main different linguistic structures. These linguistic structures are namely the use of copula be, passive voice, subordinate clauses, and the verbs “mean”, “tell”. The following figure presents the general distribution of these structures.

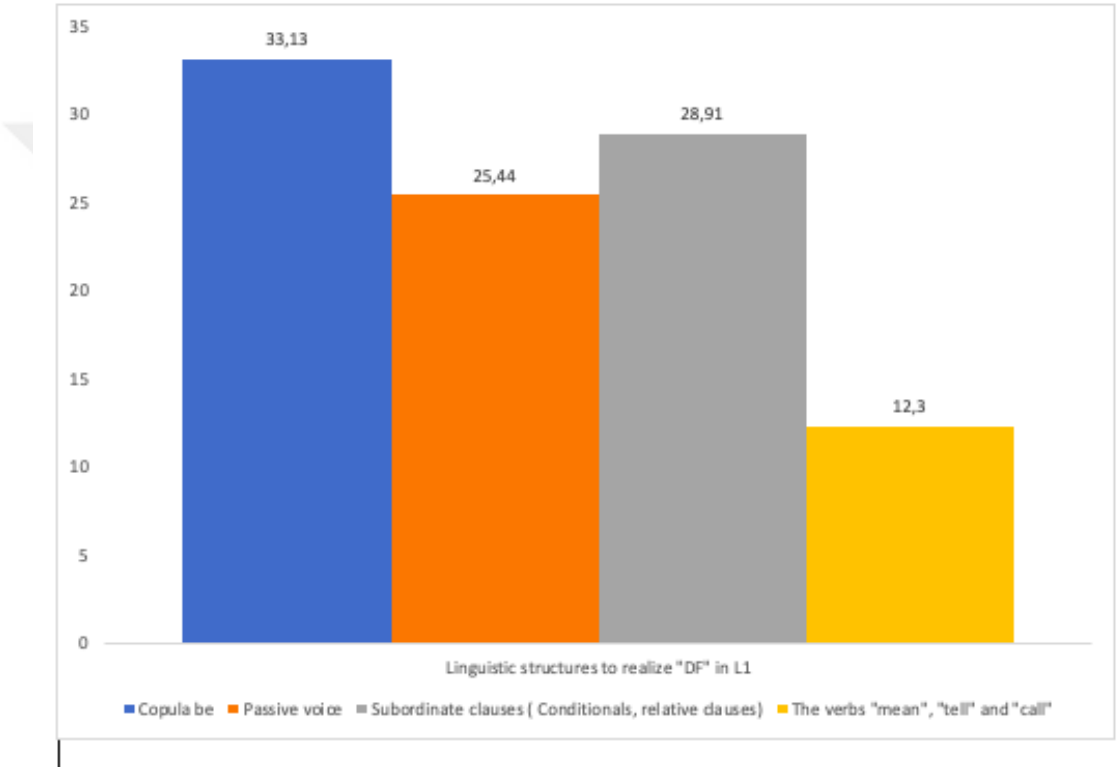

Figure 16. Distribution of the linguistic structures to realize the CDF “Define” in L1

Referring to the Figure 16, it can be stated that the definitions given through the use of “Copula be” has the highest ratio in L1. The following excerpts are the examples of such kinds of definitions observed in L1.

Excerpt 30
Example 1 of a definition through the use of copula "be" in L1

2	T1	Bond enthalpy… Bond enthalpy *is* a measure of stability of the molecules or the bonds.

In Excerpt 30, it can be observed that T1 firstly utters the term to be defined. Then, she gave the definition by using "Copula be" structure.

Excerpt 31
Example 2 of a definition through the use of copula "be" in L1

89	T1	Here you may use Hess's law to calculate DH sublimation. If you look at this one *(Showing on the board)* … Sublimation *is* the process of melting plus vaporization.

In Excerpt 31, T1 was talking about the visuals on the board. Then, she pointed to a particular visual, which was about sublimation, and defined it through the use of copula "be".

As can be seen, the utterances formulated through the use of copula be structure were observed in a vast majority of the definitions occurred in L1. T1 used these kinds of structures to introduce new terms and, sometimes she supported her definition through her drawings on the blackboard and slides. It was noted that most of the students were constantly taking notes of what T1 said during those occasions.

Other common trends in the realization of the CDF "Define" in L1 were the use of subordinate clauses and passive voice. These two occasions were found to be equal in L1. The following excerpts present the use of relative clauses to realize the CDF "Define".

Excerpt 32
Example 1 of a definition through subordinate clauses in L1

433	T1	So, now, this one, water what is the phase state of water at room temperature?
434	Ss	Liquid.
435	T1	Room temperature is the temperature *that* we live in. It is 25 degrees

Excerpt 33
Example 2 of a definition through subordinate clauses in L1

526	T1	Okay. Any questions regarding the ionic bond formation? (..) Now, we will talk about covalent bonds. So, *covalent bonds are* chemical bonds *in which* 2 or more electrons are shared by the 2 atoms.

As can be seen, the use of relative clauses was detected in a range of definitions in L1. As well as T1's definitions from her own mind, she also used relative clauses while defining something on the blackboard and in the textbook. It was observed that T1 preferred to use these kinds of definitions when she was required to give more details about the concept which was needed to be defined. By this way, she could add more information that led to a deeper understanding of the concept. As far as I observed, T1 chose to use relative clauses while defining the terms whose functions or properties were not previously known by the students, which necessitated addition of more details.

Excerpt 34
Example 3 of a definition through subordinate clauses in L1

11	T1	*If* the energy you supplied for the reactant is less than the energy released for the product, then that reaction *is an exothermic* reaction.

Besides, T1 also preferred to give definitions by using conditionals when introducing a term. Excerpt 34 shows an occasion of this phenomenon while introducing the term exothermic. While doing this, T1 mostly formed sentences whose agents were the students (e.g., If the energy *you* supply...). Personally, I have the opinion that this helped students grasp the concept better because they had the chance to regard themselves as the doer of the action.

The use of passive voice was also found to be prevalent just like subordinate clauses in T1's definitions. The following excerpts show some occasions in which passive voice was used to define a concept or term.

Excerpt 35
Example 1 of a definition through passive voice in L1

462	T1	Although these molecules are non-polar, other molecules are species again. One polar molecule can induce one non-polar molecule and such forces *are called* dispersion forces.

Excerpt 36
Example 2 of a definition through passive voice in L1

100	T1	And now we have gas molecules, and those gas molecules will also go back into liquid phase again, and that phase change *is named as* condensation.

Excerpt 37
Example 3 of a definition through passive voice in L1

87	T1	And in some substances, there is a direct change from solid to gas *which is called* sublimation. The reverse of that process *is called* deposition.

The passive voice to realize the CDF "Define" was generally constructed with the use of the verb "Call" to introduce a term. In Excerpt 36, a different passive structure (i.e., *is named as*) was also used to give a definition. While Excerpts 35 and 36 show the mere usage of passive voice in definitions, Excerpt 37 presents the mixture of the use of both passive voice and relative clause together to form a definition. As can be seen, deeper and more detailed definitions were delivered through the use of these structures instead of only using "Copula be" structure.

T1 also used the verbs "mean" and "tell" to give definitions in her lectures. The following excerpts show this phenomenon.

Excerpt 38
Example 1 of a definition through the verbs "mean" and "tell" in L1

40	T1	Two electrons cancel out. So, no net spin. So, the atom is...?
41	Ss	Diamagnetic.
42	T1	Diamagnetic, right. Diamagnetic *means* all electrons are paired up.

In Excerpt 38, it can be seen that the teacher firstly mentioned the thing to be defined, and then she gave its meaning through the verb “mean”. It can be seen that T1 preferred a range of different linguistic structures to realize the CDF “Define” rather than being stuck to a specific structure.

4.4.2.2. The linguistic structures used to realize the CDF “Define” in L2

In L2, definitions were realized through a set of different linguistic manifestations just like L1. As different from the departmental general chemistry lecture, it was observed that T2 occasionally used the active version of the verb “Call” to give definitions in addition to the use of the passivized phrase “It is called X”, which is shown in the following excerpts. The following figure shows the general distribution of the linguistic manifestation to realize the CDF “Define” in L2, which is the general chemistry lecture across disciplines.

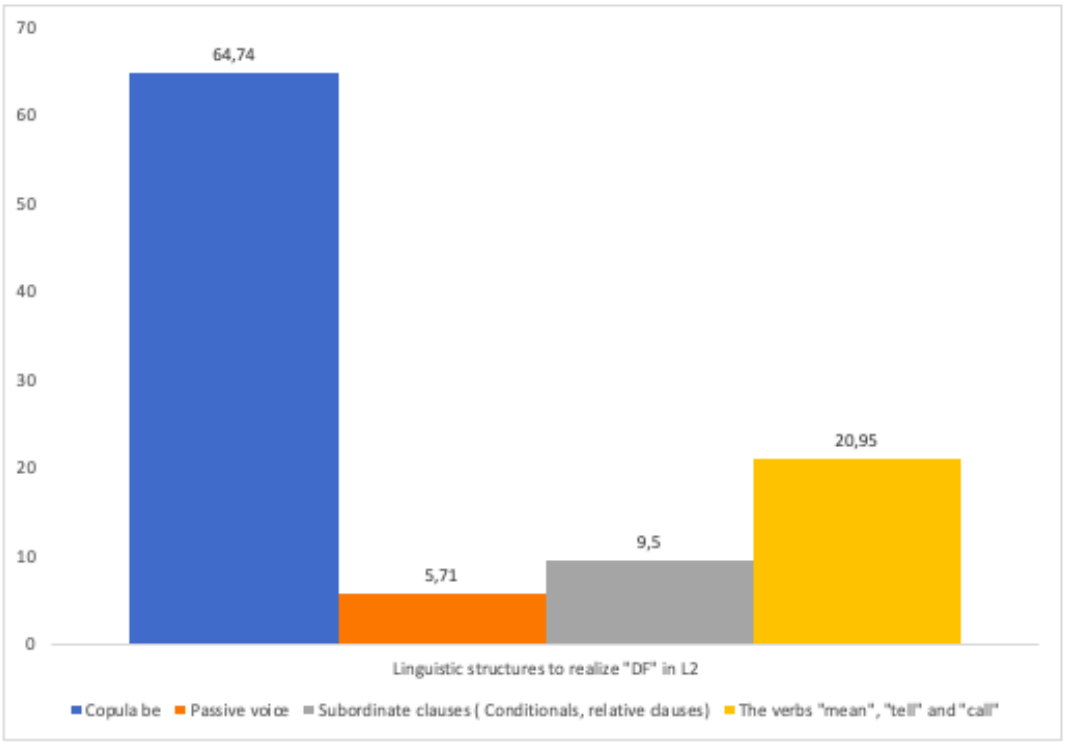

Figure 17. Distribution of the linguistic structures to realize the CDF “Define” in L2

As can be seen, the majority of the definitions was given through the use of the linguistic structure “Copula be”. As a different finding from L1, definitions

made through the use of the verbs “Mean” “Tell” and “Call” occupied a larger place in L2. Besides, T2 used statements like “You/we call this X” to give definitions. In L1, the use of the verb “Call” was generally included in the passive structure in the utterances like “This is called X”. However, T2 also occasionally preferred to use the active version of the verb in this lecture to define a thing or concept. The following excerpts present the linguistic manifestation of the CDF “Define” in L2.

Excerpt 39
Example 1 of a definition through the use of copula be in L2

14	T2	Ionization *is* the stability of valence electrons reflected on the ionization energy. Ionization energy *is* the minimum energy to remove an electron from here. If you want to remove an electron, you need the energy.

T2 used “Copula be” to give both verbal and visual definitions that were drawn on the board or shown through the slides. Structures like these were frequently used in L2 while giving definitions.

Excerpt 40
Example 2 of a definition through the use of copula be in L2

10	T2	So, the wavelength *is* the distance between identical point successive waves. So, the first crest and this is the second crest. And the distance between these two crests *is* wavelength, and the amplitude *is* the vertical distance between the midline of a wave and its peak.

It was observed that T2 tended to use this linguistic structure while defining most of the terminologies.

Excerpt 41
Example 1 of a definition through subordinate clauses in L2

4	T2	And these are the elements *that* exist 20 degrees in 1 atmospheric pressure *(Showing on the board)* like nitrogen, oxygen, fluorine, and chlorine. These are the diatomic molecules, and these are the gases at 20 degrees...

Excerpt 42
Example 2 of a definition through subordinate clauses in L2

20	T2	You are using a barometer to measure the pressure of the atmosphere. What about measuring the pressure rather than the atmosphere? We are using manometers. Manometers are devices *used to* measure the pressure gases other than the atmosphere.

Definitions given through the use of relative clauses in L2 had a smaller ratio when compared to L1. There were only seven instances of such usages of relative clauses throughout all L2 sessions. Likewise, the use of passive voice was found to be similar to the use of relative clauses for the purposes of giving definitions.

Excerpt 43
Example 3 of a definition through subordinate clauses in L2

26	T2	And *if* there is a positive value, *it means* that the reaction *is* endothermic. *If* it is negative, the reaction *is* exothermic. So, all bond-breaking, you can break the chlorine, you can break the hydrogen chloride.

An instance of the use of "Conditional clauses" to define something can be seen in Excerpt 43. T2 established his definitions on a conditional situation in these kinds of occasions.

Excerpt 44
Example 1 of a definition through passive voice in L2

25	T2	So, the Lewis structure does not say anything about the molecular arrangement of the atoms in this case. So, for the molecular arrangement, the approach or the study of molecular geometry *is called* valence shell electron pair.

Excerpt 45
Example 2 of a definition through passive voice in L2

2	T2	Okay, this part is from boron, carbon, nitrogen, and oxygen... The first and second column... They *are known as* representative elements *(Pointing to the board).*

Just like the use of relative clauses for definitions, passive voice was not observed frequently in L2. T2 preferred to give some background information before using a passive structure to define a concept. Excerpts 44 and 45 show how T2 used passive structures to give definitions.

There were also other structures used for the purpose of definition. These structures were mostly the use of the verb "mean" and "call". There were also instances of the phrases like "We call this X", even though they were not common.

Excerpt 46
Example 1 of a definition through the verbs "mean" and "tell" in L2

19	T2	Diamagnetism *means* all electrons are paired. If you look at the second row of the periodic table, is beryllium paramagnetic or diamagnetic?

In Excerpt 46, an example of the use of the verb "Mean" to define something can be seen. These kinds of utterances were observed in a number of times throughout L2.

Excerpt 47
Example 2 of a definition through the verb "call" in L2

17	T2	Using two atomic orbitals. You can get the molecular orbital. Hydrogen-hydrogen… Single bonds... And we *call* these sigma bonds.

In Excerpt 47, T2 firstly showed the properties of the bonds on the board. Then, he named these structures by using the verb "call" without preferring a passive structure.

4.4.2.3. The linguistic structures used to realize the CDF "Define" in L3

One important finding regarding L3 is that the use of metatalk occupied almost one third of the total definitions. These kinds of structures were mostly based

on the use of the words “define and definition” explicitly. T3 used metatalk to give definitions through structures like “We define X as...” and “The definition of X is...”. The following figure shows the general distribution of the linguistic structures used to give definitions in L3.

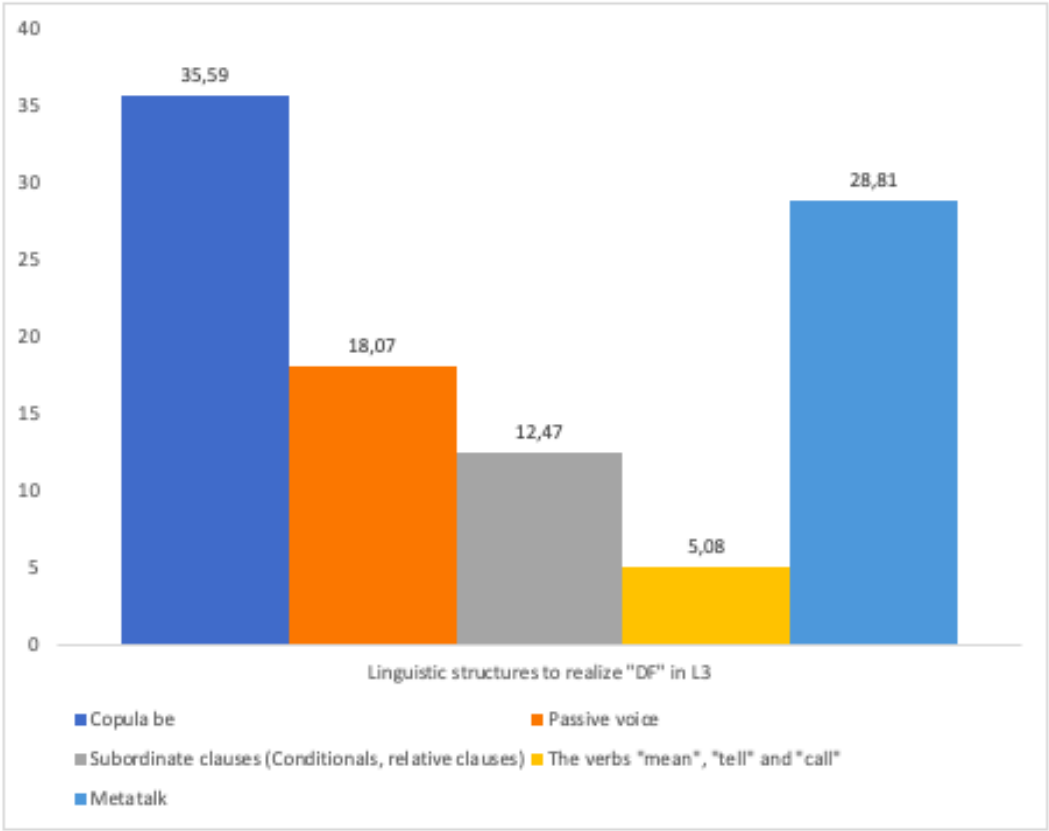

Figure 18. Distribution of the linguistic structures to realize the CDF “Define” in L3

The use of “Copula be” structure again constitutes the biggest part among all definitions occurring in L3 just like L1 and L2. The use of “Metatalk” in definitions is the second most observed way. The use of subordinate clauses and the verbs “Mean” and “Tell” to give definitions were found to be almost equal in L3. The following excerpts show the linguistic manifestations of definitions in L3.

Excerpt 48
Example 1 of a definition through copula be in L3

17	T3	What is sigma? Sigma *is* the surface mass density. Just read the text in the textbook. You can find it dividing the total mass by the total area of this.

In this excerpt, it can be seen that T3 used "Copula be" structure while giving a definition.

Excerpt 49
Example 2 of a definition through copula be in L3

10	T3	*Change in the displacement in per unit time. What's that?* Maybe it *is* angular velocity, right? To define the angular velocity first we have to define angular position…

It can be observed that T3 used copula structure to give definitions but slightly different from the usages observed in L1 and L2. In Excerpt 49, it is seen that T3 firstly mentioned the concept to be introduced which was "Change in the displacement in per unit time". Then, he asked a rhetorical question – "What is that?"-. Without expecting an answer from the students, he gave the definition which was "It is angular velocity".

Excerpt 50
Example 3 of a definition through copula be in L3

13	T3	That is MG final minus MG initial. This *is* the change in the potential energy, gravitational potential energy. Am I right?

T3 firstly uttered the term to be defined. Then, he formed a sentence starting with "This" to give a definition rather than giving the definition through copula structures in utterances like "X is Y". Therefore, he preferred to present the sentences in separate chunks.

Excerpt 51
Example 1 of a definition through subordinate clauses in L3

40	T3	And then they fire the same kind of bullet in the lab, in the laboratory. Right, okay? They are just working on some ballistic search. Yes, okay, anyway. The ballistic pendulum is an apparatus *used to* measure the fast-moving projectile. For example, a bullet…

These kinds of usages were not frequently observed throughout L3 for the purpose of defining something. Nonetheless, they were occasionally preferred by T3.

Excerpt 52
Example 1 of a definition through metatalk and subordinate clauses in L3

05	T3	Now, you can give another *definition* of conservative force. *If* the integral of the force over a close path is zero again, you can *call* this again a conservative force.

In the Excerpt 52, metatalk, conditional clause and the verb "Call" were included in the definitions of the term "Conservative force". Because the introduction of the term to be defined (i.e., *Conservative force*) was done through the use of conditional clauses, this usage was labelled as a subordinate clause.

Excerpt 53
Example 1 of a definition through passive voice in L3

08	T3	You cannot find this term in the textbook but next year if you take dynamics…The term *is called* relative approach velocity. Check the spelling...relative approach velocity.
09	S3	Aa, var galiba [TR]. *(I guess, it is present)*
10	T3	Which one?
11	S3	O'dan sonra var hocam [TR]. *(It is present after O)*
12	T3	Yes...Yes, it is here. Okay, thank you. Relative approach velocity… What about this one? After the collision this difference *is called* relative separation velocity. Okay, so, basically, if the collision is an elastic collision, you can use these two equations to work on any problem including the collision impact of two particles.

Excerpt 54
Example 2 of a definition through passive voice in L3

10	T3	Let's talk about the impulsive force during the interaction or collision, okay? There is a force exerted on an object by the other one during the interaction *(Showing on the board).* So, this *is called* impulsive force.

Passive structure was also frequently preferred by T3 to give definitions. The general tendency of T3 was to firstly introduce some kind of background knowledge

about the term to be introduced. Then, he gave the definition through the passive structure.

Excerpt 55
Example 1 of a definition through the verbs "mean" and "tell" in L3

98	T3	Planar... Planar *means* two dimensions. You can say that it's a two-dimensional motion.

In Excerpt 55, an occasion in which the verb "Mean" was used to define the term "Planar". However, these kinds of usages were not as prevalent as the use of copula be and passive structure in L3.

4.4.2.4. The linguistic structures used to realize the CDF "Define" in L4

The observation and recording period of the dynamics lecture (L4) was shorter than that of the other lectures. Therefore, the number of CDF types observed is accordingly fewer than the others. The following figure shows the linguistic structures used to realize the CDF "Define" in L4.

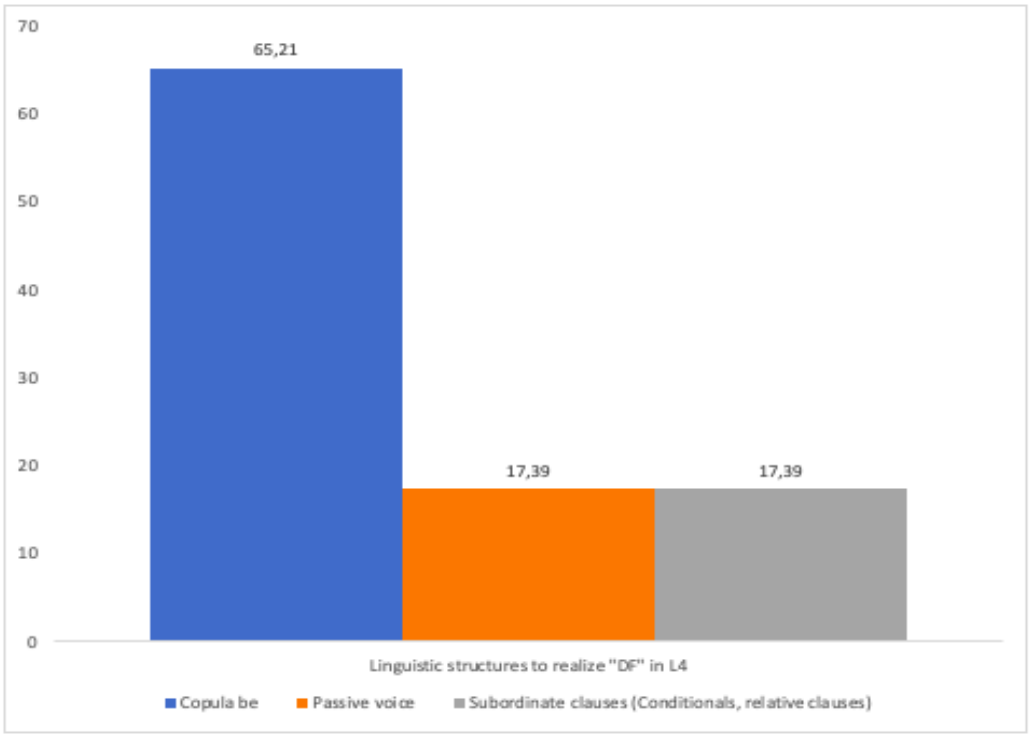

Figure 19. Distribution of the linguistic structures to realize the CDF "Define" in L4

It was found out that the use of "Copula be" was the most preferred linguistic structure to give definitions in L4. The use of passive voice and subordinate clauses were found to be equal. There were no instances of metatalk, or the verbs "Mean" and "Tell" while giving definitions. The following excerpts show some examples of linguistic realization of the CDF "Define" in L4.

Excerpt 56
Example 1 of a definition through copula be in L4

2	T3	Torque force moment *is* a quantity responding force. Linear position is corresponding to the angular position, theta.

Out of 23 definitions, 15 of them were formulized through the use of "Copula be" in L4. T4 preferred to use these kinds of definitions while introducing terminologies that could be given without further details.

*E*xcerpt 57
Example 1 of a definition through subordinate clauses in L4

4	T3	Composite bodies…*What are composite bodies?* For example, an object *which consists of* more than one part... And… Let's see, each part has a specific geometry.

Referring to my field notes, it can be stated that T4 tended to use definitions through subordinate clauses to give more detailed definitions about the concepts.

Excerpt 58
Example 2 of a definition through subordinate clauses in L4

31	T3	Perpendicular distance between the direction of the linear acceleration and the rotational access …Now, what kind of motion is this, translational motion but *if* this is just along a straight line, what do you *call* it? Rectilinear motion.

Conditionals were also preferred by T3 to realize the CDF "Define" in L4. In this occasion, it can be seen that the use of the verb "Call" in its active form which was also occurred in L2 which was the general chemistry lecture across disciplines.

However, the use of the verb “Call” is combined with a conditional clause in L4. That was the reason why it was examined under the category of the use of subordinate clauses in definitions.

Excerpt 59
Example 1 of a definition through passive voice in L4

36	T3	So, it is the center of mass as a velocity. So, we can talk about the kinetic translational kinetic energy of 1 over 2 M, V, G square, but let’s say now, it is rotating about an axis? As well it is an angler velocity omega. Okay, so... Kinetic energy has one more turn that *is called* translational kinetic energy.

Passive voice was used again in definitions after a certain kind of background knowledge was given about the term to be introduced. For example, in Excerpt 59, T4 touched upon some formulaic expressions about the term translational kinetic energy. Then, he explicitly introduced the term by using passive structure.

Regarding the general tendency to use “Copula be" structure, it can be stated that its preference was based on the definition of certain discipline-based terminologies related to chemistry, physics and dynamics. When detailed information about the terms was to be given, teachers usually preferred to use the structures “Relative clauses” and “Passive voice” instead of “Copula be”. Other structures including “Conditionals” or the verbs “Mean”, “Tell” and “Call” were also preferred by the teachers on a number of occasions depending on the terms to be defined. That is, the preference over a particular linguistic structure was dependent on the extent to which the terms needed to be supported by extra details or not. For example, certain kinds of chemical reactions were hard to be defined by the use of “Copula be” because they included specific processes or conditions. Those processes required the inclusion of a number of details which could be delivered more easily through the use of “Subordinate clauses”, “Passive voice” or other structures rather than “Copula be”. The following figure shows the general distribution of the linguistic structures used to realize the CDF “Define” in all observed lectures.

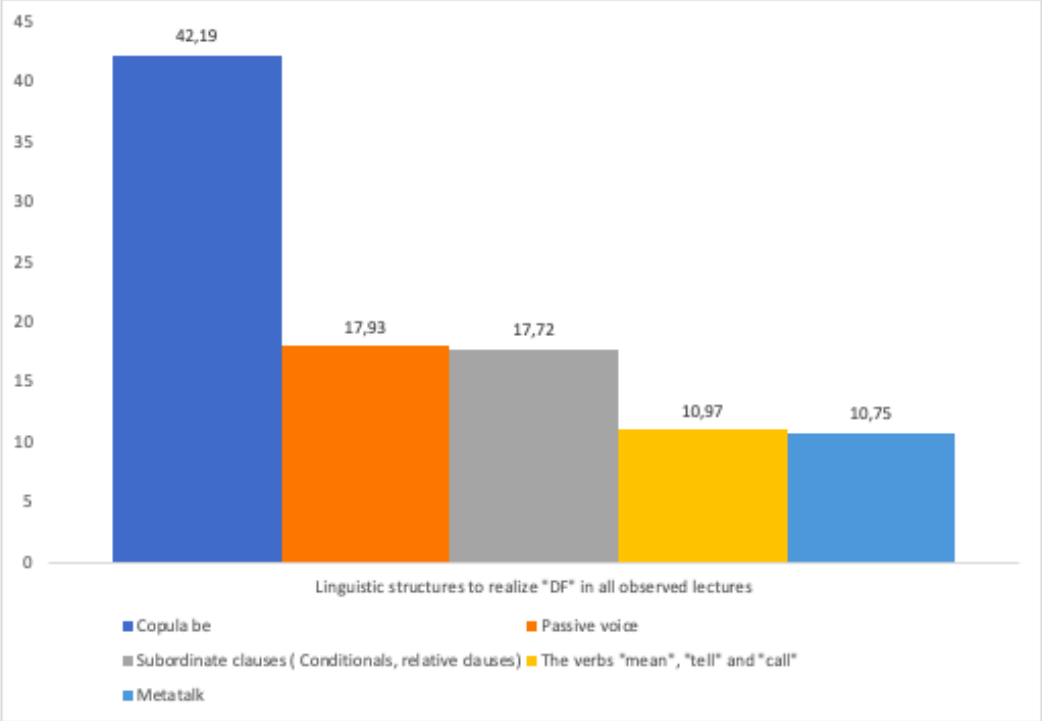

Figure 20. The general distribution of linguistic structures used to realize the CDF "Define" in all observed lectures

Referring to Figure 20, it is clear that the use of the structure copula be was the most prevalent in definitions throughout all observed lectures. Passive voice and subordinate clauses were found to be almost equal in number. Even though metatalk in definitions was only employed by T3, its ratio is almost equal to that of the verbs "Mean", "Tell" and "Call". Therefore, it can be stated that metatalk was an undeniable component of definitions at least in the observed physics lectures.

4.4.3. The CDF "Describe"

Physical, structural, functional and process descriptions were observed in the framework of the CDF "Describe" throughout all lectures. All of these description types were realized through different linguistic structures.

For physical descriptions, the prevalent linguistic structures were the use of prepositions of location and adjectives about the physical state of things or materials. Structural descriptions were realized through the use of the verb "Have", which

indicates the properties, qualities or inner dynamics of the things. The sentences regarding the function of something and the statements like “X is used for...” and “X can do...” were included in the functional descriptions. Process descriptions were generally realized through the use of phrases like “The first/second step” and “Firstly, secondly...”. In brief, when utterances about the steps of an action or process were observed, they were labelled as process descriptions. The realization of these description types in each individual lecture is examined in detail in the following sections.

4.4.3.1. The linguistic structures used to realize the CDF “Describe” in L1

In this departmental Chemistry lecture, the number of physical descriptions outnumbered the other types. There were a number of sentences regarding the shape of chemical compounds, which were coded as physical descriptions. Besides, utterances about the physical state of chemical compounds or angles of molecules were also evaluated as physical descriptions. The least observed type was functional descriptions in L1. All of the description types were manifested through a range of different linguistic preferences. The following excerpts show the linguistic structures used to realize the CDF “Describe” in L1.

Excerpt 60
Example 1 of a physical description in L1

9	T1	If these are, as I told you, within the same plane as this one… And the unhybridized P orbital is *perpendicular* on that one so these are the unhybridized P orbitals, okay? What will happen to them? These are *perpendicular*, they will also overlap *side by side* to form to pi bonds *between the two*. So, this is the sigma bond.

In Excerpt 60, T1 described the physical state of P orbital on the board by using the adjective *perpendicular*. Besides, the overlap of P orbitals was described as *side by side* which was also counted as a physical description.

Excerpt 61
Example 1 of a structural description in L1

124	T1	If you look at this oxygen, what do you see? All electrons are paired in terms of magnetism. What does it tell me? Is it paramagnetic
125	Ss	diamagnetic?
126	T1	Diamagnetic? *Oxygen is not diamagnetic. It is paramagnetic*, which means that it should *have* unpaired electrons.

In Excerpt 61, T1 talked about the quality of the chemical compound oxygen by stating that it was paramagnetic. Then, she continued her utterance with the verb "Have" to state that having unpaired electrons should be one of the properties of a paramagnetic oxygen molecule. Therefore, this can be an example of a structural description in L1.

Excerpt 62
Example 1 of a functional description in L1

55	T1	Molecules like water… So, these are soft compared to the previous ones because the interactions are not that much strong like the covalent bonds and ionic bonds, so they *have* lower melting point, and *these are pure conductors of heat and density.*

In Excerpt 62, T1 was talking about liquid molecules. The statement "*These are pure conductors of heat and density"* described the function the molecules. Thus, these types of structures in which the function or capability of something was told were coded as functional descriptions. On this occasion, that word was *"conductor"*.

Excerpt 63
Example 1 of a process description in L1

94	T1	Tell me the total valence electrons for this molecule. Oxygen is 6, fluorine is 7. So, seven times two. It is 14. Which one to put into the middle as the central atom?
95	Ss	Oxygen.
96	T1	And connect it to fluorine. *The first step* is to draw the Lewis structure. *Okay, so, I used 4 electrons and completed the octet for the florins.* Any shift or double bond formation, anything other? Is it the correct Lewis structure?
97	Ss	Yes.

In Excerpt 63, T1 was talking about the process of drawing chemical compounds on the board. Therefore, she used the phrase “The first step is...”. Then, she continued to give detail about how to draw the Lewis structure. This was an example of a process description in L1.

4.3.3.2. The linguistic structures used to realize the CDF “Describe” in L2

In L2, physical and process descriptions were found to be equal. Together, they composed more than half of the total descriptions. Just like L1, functional descriptions were the least observed ones. The following excerpts show the linguistic manifestations of description types in L2.

Excerpt 64
Example 1 of a physical description in L2

3	T2	You need to memorize this molecular geometry. Four atoms around the central elements and the lone pairs... Ups, there are no lone pairs. *The geometry is tetrahedral*. This is phosphorus trichloride. Arrangement of electron pairs is *triangular pyramidal*. So, *the bond angle between these is 90*. No lone pairs on *the central atom* and *six pairs around the central atom*. So, tetrahedral. Sulphur tetrafluoride.

T2 talked about the molecular geometry of chemical compounds. While doing this, he used the name of the shapes like tetrahedral and the bond angles. Besides, he also described the physical arrangement of the atoms in the compounds by using phrases like “On the central atom” and “Around the central atom” in which prepositions of location were used. Therefore, these kinds of utterances were coded as physical descriptions.

Excerpt 65
Example 1 of a structural description in L2

18	T2	In this part, we are comparing nitrogen and fluorine. Nitrogen *has* seven protons, and the fluorine *has* nine protons.

In this excerpt, T2 described the structure of nitrogen and fluorine by stating their atomic properties like the number of protons.

Excerpt 66
Example 1 of a functional description in L2

17	T2	So, sodium azide *is used* in some airbags. This is the sodium azide *(Showing on the board).* So, if you break down the sodium azide you can get the sodium and nitrogen gases.

Here, it can be seen that one of the usage areas of sodium azide was told by T2, which was coded as a functional description.

Excerpt 67
Example 1 of a process description in L2

19	T1	You can find the mass of the ionic compounds. *The first step* is to dissolve the unknown substance in the water. You have water and a beaker. Just pour the water into beaker and dissolve it then react the unknown substance with the known one to precipitate

In Excerpt 67, T2 gave detail about the way of finding the mass of an ionic compound. While doing this, he used the phrase "The first step", which signaled the initial action of the process. Then, he continued to give details about the rest of the process. There were a number of similar utterances like this throughout L2, which were all labelled as process descriptions.

4.4.3.3. The linguistic structures used to realize the CDF "Describe" in L3

In the Physics lecture, process descriptions were found to be the most occurring type of descriptions followed by physical descriptions. The following excerpts show some examples of the description types observed in L3.

Excerpt 68
Example 1 of a physical description in L3

42	T3	Let's say this is the position of the spring *(Showing on the board),* that means spring is not compressed or stretched. Somehow you just change this from its initial position to the final position, what is the direction of the spring force? Just *opposite of the displacement.* This is the direction of the displacement.

In Excerpt 68, T3 talked about the position of the spring that he drew on the board. Then, referring to the question in the book, he described its physical position by using a preposition of location which was "The opposite of". That was the reason why examples like this were evaluated as physical descriptions.

Excerpt 69
Example 1 of a structural description in L3

3	T2	Okay, this is a spring-loaded pump gun. It is a toy. The launching mechanism of a toy gun *consists of a spring of an unknown spring constant*.

T3 was talking about a property of the toy gun in the excerpt 69. Because he expressed the inner mechanism of the toy gun by using the italicized phrase, the utterance was labelled as a structural description.

Excerpt 70
Example 1 of a functional description in L3

2	T2	The gun when fired vertically *is able to launch* a 35-gram projectile to a maximum height of 20 meters above the position of the projectile before firing.

In this example, it can be seen that T3 talked about the capability or function of a gun. Therefore, this utterance signaled the function of the gun, which was coded as a functional description.

Excerpt 71
Example 1 of a process description in L3

98	T1	Now… Okay, this is the wall, okay. *Initially*, the car is moving to the left with the initial velocity. *After the crash …After the collision between the wall and the car,* it starts to move to the right now. Of course, it …It is in some dimension, right? So, this is V final. So, V final is given so let's say this is the positive x axis. So, V initial vector is minus. Please tell me what that is.

Process descriptions were observed a number of times throughout L3. Excerpt 71 was one of the occasions in which T3 described a process. The topic was velocity. Therefore, he gave an example of a car crash. He told the process with the help of the adverbials like *initially* and *after*, which made it a process description.

4.4.3.4. The linguistic structures used to realize the CDF "Describe" in L4

In the dynamics lecture, there were only four instances of descriptions and all of them were structural descriptions. The following excerpt shows an example of structural description observed in L4.

Excerpt 72
Example 1 of a structural description in L4

35	T2	The rigid object *has* a translational motion. So, it is the center of mass as a velocity. So, we can talk about the kinetic translational kinetic energy…

.

In Excerpt 72, T4 was talking about rigid objects and their features. He talked about their structure by stating that rigid objects had a translational motion. Therefore, such utterances were investigated under the category of structural descriptions.

Due to the absence of clear-cut separations between the linguistic forms used to realize the CDF "Describe" in all lectures, no figure regarding the distribution of linguistic manifestations was provided. I personally thought that examining those structures through excerpts would give better insights. Nonetheless, it can be stated that the use of prepositions of location and adjectives about the physical properties of objects were regarded as physical descriptions. The use of the verb "Have" to talk about the inner dynamics or mechanism of objects was evaluated as structural descriptions. Functional descriptions were generally realized through the statement like "X is used for…" and "X does this…". Finally, process descriptions were signaled by the use of the sequencers like "The first/second/third/next step..." or adverbs like "Initially/firstly/secondly...". Besides, utterances about certain processes

including the steps of solving a problem or occurrence of a chemical reaction or physical movement were labelled as process descriptions.

4.4.4. The CDF "Evaluate"

Dalton-Puffer states that the function of evaluate is to determine the value of something in terms of something already known. She also states that personal interpretations are among the important parts of evaluations (2016: p.41). However, this CDF type was the least observed one among all types. Out of 1666 CDFs, only 68 of them were the CDF "Evaluate". There was no place for personal judgments and interpretations in all of the observed lessons because they were all about physical science classes. This CDF was realized through the use of adjectives and adverbs (i.e., *important(ly), careful(ly), better, easy/easily*) throughout all observed lectures. Referring to their own background knowledge, the teachers tried to emphasize the importance and easiness of some topics, or they tried to warn students about being careful about complex issues. The adjective "Important" was used when teachers tried to emphasize the significance of a topic or point during lectures. When teachers wanted to warn students about something that would be tricky or complicated, they used the adjective "Careful" by uttering sentences like "Be careful about this.". "Better" was used when the teachers preferred a method, approach, or equation over another because they thought that it would be more useful in that way. Lastly, when they wanted to encourage students to engage in the exercises, they formulated utterances like "It is easy, you can do it" and "It is easy to calculate/find this...)". Because all of the evaluations were realized through the use of particular adjectives and adverbs, no visual was provided regarding the linguistic manifestations of the function. The excerpts which show the occasions in which those adjectives and adverbs were used to make evaluations are presented in the following sections.

4.4.4.1. The linguistic structures used to realize the CDF "Evaluate" in L1

In the departmental general chemistry lecture, the CDF "Evaluate" was mostly realized through the use of the adjective "Important". When an issue was of

importance or hard to grasp, T1 used this adjective. The following excerpt shows an occasion in which the adjective "Important" was used by T1 to make an evaluation.

Excerpt 73
Example 1 of an evaluation through use of adjectives in L1

81	T1	Let's consider sodium chloride. The formation of sodium chloride. What happens there? Chlorine gains that electron, so sodium loses electron from its valence orbital. That's why these valence electrons are very *important* because they are the ones that enter the reaction.

In Excerpt 73, T1 tried to highlight the importance of valence electrons because of their functions. There were also other adjectives regarded as evaluations. For instance, when T1 wanted to warn students against the complexity of a term or chemical reaction, she used phrases like "Be careful about X.." or she said "It is better to use this theory because…" when she found a theory more useful.

4.4.4.2. The linguistic structures used to realize the CDF "Evaluate" in L2

In this general Chemistry lecture, T2's general tendency to make evaluations was to use the adjective "easy". When he thought that a formula was easy to use, he uttered sentences like shown in the following excerpt to encourage students to use that formula or approach.

Excerpt 74
Example 1 of an evaluation through use of adjectives in L2

12	T2	It is for nitrogen. If you want you can memorize this one, or another way which is *easy* for you... 1S, 2P, 2S, and 3D…. and so on. Write the four quantum numbers for an electron in 3p orbitals. Okay, I am writing. The principal quantum number is three, so M is three what about l?

In this excerpt, T2 suggests an easy way for students to memorize the molecular orbitals better. These kinds of sentences were examined as evaluations because they stated the teacher's personal judgments regarding the easiness of their applicability.

4.4.4.3. The linguistic structures used to realize the CDF "Evaluate" in L3

In the physics lecture, T3 tended to make evaluations based on the adjective "Careful". Regarding the complex parts of the lecture, T3 warned the students about being careful about particular points on some occasions. The following excerpt presents an occasion in which an evaluation was done through the use of the adjective "Careful".

Excerpt 75
Example 1 of an evaluation through use of adjectives in L3

9	T3	I didn't use the vector notations because the motion is along a straight line. Let's say this is the x axis, so that is why I just use the scalar form of the equation, but you need to *be careful* about the sign of the velocity if it is in a positive direction, velocity should be negative, right?

In excerpt 79, T3 warned the students about the sign of the velocity. He probably thought that it would be a tricky point for the students.

4.4.4.4. The linguistic structures used to realize the CDF "Evaluate" in L4

T3's tendency regarding evaluations was similar in his dynamics lecture, too. Again, the most remarkable pattern was the use of the adjective "Careful" to warn students about challenging or complex parts. The following excerpt demonstrates an occasion in which an evaluation was made by T3.

Excerpt 76
Example 1 of an evaluation through use of adjectives in L4

24	T4	Because it is moving this way, that's why, but *be careful* if the truck accelerates greater than this value. Which direction? This table to this side to the back, so that's why this is the direction of the force of friction NSA and NSB, okay? Understood?

In Excerpt 76, T3 tried to warn the students about the speed of the truck which was in the practice question. To avoid potential student mistakes, T3 formulated such kind of utterances which were regarded as evaluations because they were about the teacher's personal stance towards the point in question.

4.4.5. The CDF "Explain"

The CDF "Explain" was the most observed type throughout all lectures. When all the lectures were examined, it was found out that this CDF type was realized through three main linguistic structures: Subordinate clauses (e.g., *because, since, when, that is why, if*), coordinate clauses (e.g., *and, so*) and conjunctive adverbs (e.g., *hence, as a result*). Detailed examples and distributions of those linguistic structures based on individual lectures are presented in the following sections.

4.4.5.1. The linguistic structures used to realize the CDF "Explain" in L1

In the general Departmental Chemistry lecture, the most observed CDF type was "Explain". This CDF was realized through a range of different linguistic structures. The following figure shows the distribution of linguistic manifestations of the CDF "Explain" in L1.

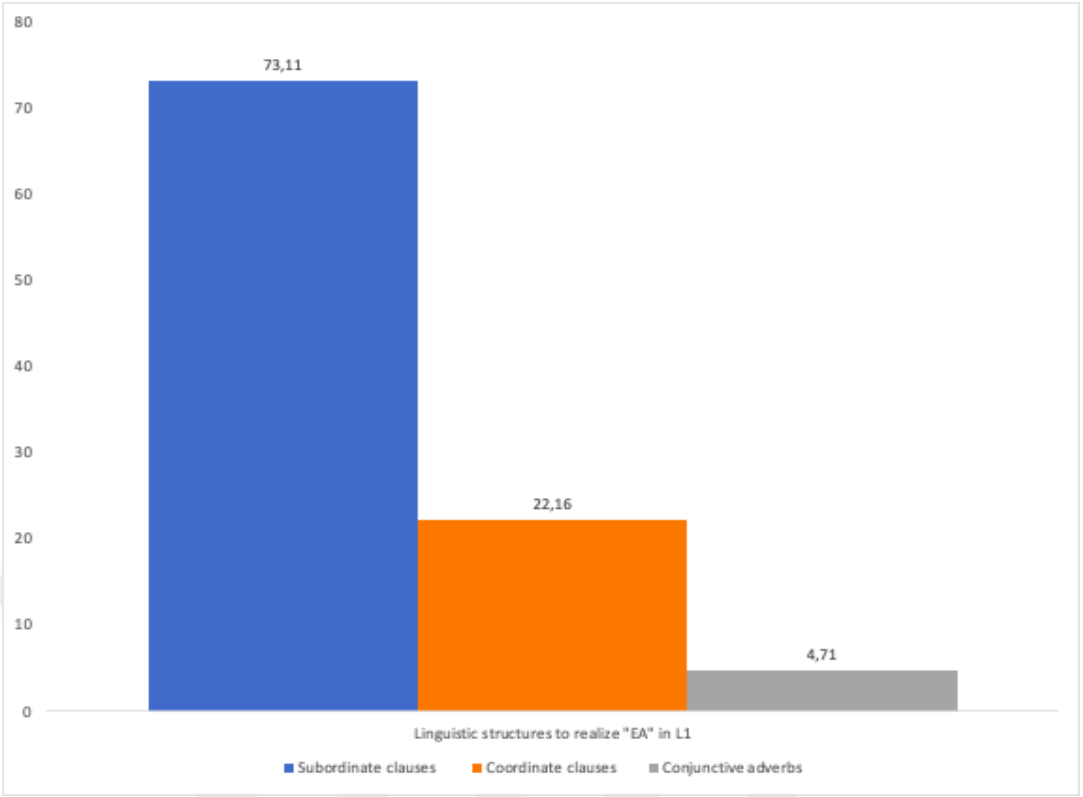

Figure 21. Distribution of the linguistic structures to realize the CDF "Explain" in L1

Referring to Figure 19, it can be stated that the most prevalent linguistic structure used to realize the CDF "Explain" in L1 was subordinate clauses. Subordinate clauses were formed through the use of subordinate conjunctions and relative clauses. The following excerpts present how subordinate clauses were formed during explanations in L1.

Excerpt 77
Example 1 of an explanation through subordinate clauses in L1

4	T1	At that time, people wouldn't know the electron, proton, the electron configuration, they have understood that there are some similarities between these elements that were discovered, and they tried to group those elements with respect to those properties. The first thing that they tried to do is to group these elements based on their atomic mass *because* at that time, they were able to determine the atomic mass, not the electron number *because* the electron was not even discovered at the time.

The subordinate conjunction “Because” was one of the most observed structure used in explanations in L1. In Excerpt 77, it can be seen that the reason why chemical elements were grouped based on their atomic mass in ancient times was that the electrons were not discovered at that time.

Excerpt 78
Example 2 of an explanation through subordinate clauses in L1

55	T1	Every species in the periodic table actually wants to look like to have an electron configuration of a noble gas which ends up with eighteen *because* it is this table’s arrangement for the atoms, okay? *That’s why* those noble gases are actually not reactive *because* they are already stable. They have completed their electron configuration *so that’s why* they are not reactive to enter reaction and any other species by either using or gaining electrons in the reactions, they want to look like the electron configuration of a noble gas.

“That is why” was another preferred subordinate conjunction to make explanations in L1. It can be seen that T1 used both “because” and “That is why” one after another to make detailed explanations. Besides, utterances including the phrase “So that is why” were also prevalent in L1. Sentences with “That is why” were evaluated as the use of subordinate clauses because both parts of the sentences were connected to each other, and the meaning was reduced when they were separated. Referring to the Excerpt 78, the reason why those chemical elements were not reactive was that they completed their octet, which meant they were stable.

Excerpt 79
Example 3 of an explanation through subordinate clauses in L1

68	T1	Sodium cation, this is the electron configuration for sodium cation. It is neon, right? It has a similar configuration with neon, right? Or... aluminum plus 3. *When* aluminum loses three electrons, it resembles the noble gas that comes before aluminum which is neon.

Sentences formulated with “When” were among the other subordinate structures to explain something in L1. As a result of losing three electrons, aluminum could come up with the electron configuration of a noble gas, neon. Because this sentence stated a cause-and-effect relation, it was labelled as an explanation.

Excerpt 80
Example 4 of an explanation through subordinate clauses in L1

142	T1	And here as you see *because* it is the temperature at which the vapor pressure is equal to external pressure which means that the boiling point of a liquid depends on the external pressure... So here, *if* the enthalpy of vaporization is high then molecules will be generally high boiling points.

In Excerpt 80, T1 explained the reason why some molecules had high boiling by referring to the term enthalpy of vaporization. While doing this, she used conditional structure, which was also evaluated under the title of subordinate clauses.

Excerpt 81
Example 5 of an explanation through subordinate clauses in L1

513	T1	One chlorine atom always makes a bond with another chlorine atom and when this chlorine atom comes into contact... Its valence electrons that see each other and that are parts for a chemical bonding... T*hat's why* when we talk about chemical bonding, we always concentrate on those valence electrons *since* these are the outermost and these are the electrons atoms used in chemical bonds.

In Excerpt 81, T1 explained why valence electrons are important by using the subordinate conjunction "Since". T1 used "Because" and "Since" a number of times throughout her lessons while explaining something.

Excerpt 82
Example 1 of an explanation through coordinate clauses in L1

69	T1	This is the geometry of all these bond formations, okay? What about the bond angles? We can also talk about the bond angles, right? Hydrogen carbon and hydrogen… Then it is triangular, *so the bond* angle is 120 degrees.

"So" was the most observed coordinate conjunctive throughout L1. There were also some occasions in which "So" was used as a subordinate conjunctive as it was in the structure "So that is why". However, in the Excerpt 82, it can be seen that

it connects two sentences which can be found as separate chunks, too. Therefore, these kinds of usages were coded as coordinate clauses.

Excerpt 83
Example 1 of an explanation through conjunctive adverbs in L1

68	T1	The same thermal energy, *so* iso means something that is the same. Isoelectronic here means they have the same number of electrons. *Hence*, they have the same ground state of electron configuration.

The use of conjunctive adverbs to give explanations was not as prevalent as the use of subordinate and coordinate clauses in L1. Nonetheless, there were occasions in which these adverbs were used. In Excerpt 83, T1 was talking about some chemical elements on the board. They were isoelectronic as they had the same electron configuration.

Excerpt 84
Example 2 of an explanation through conjunctive adverbs in L1

88	T1	The effective nuclear charge will increase or decrease...?
89	Ss	Increase.
90	T1	*As a result*, the atomic radius will decrease.

Just like *"Hence", "As a result"* was another conjunctive adverb used in explanations in L1. In this example, T1 made a causal relationship between the effective nuclear charge and atomic radius by using the conjunctive adverb *"As a result".*

4.4.5.2. The linguistic structures used to realize the CDF "Explain" in L2

In the General Chemistry lecture, the second observed CDF type was "Explain" after "Define. The following figure presents the distribution of linguistic structures to realize the CDF "Explain" in L2.

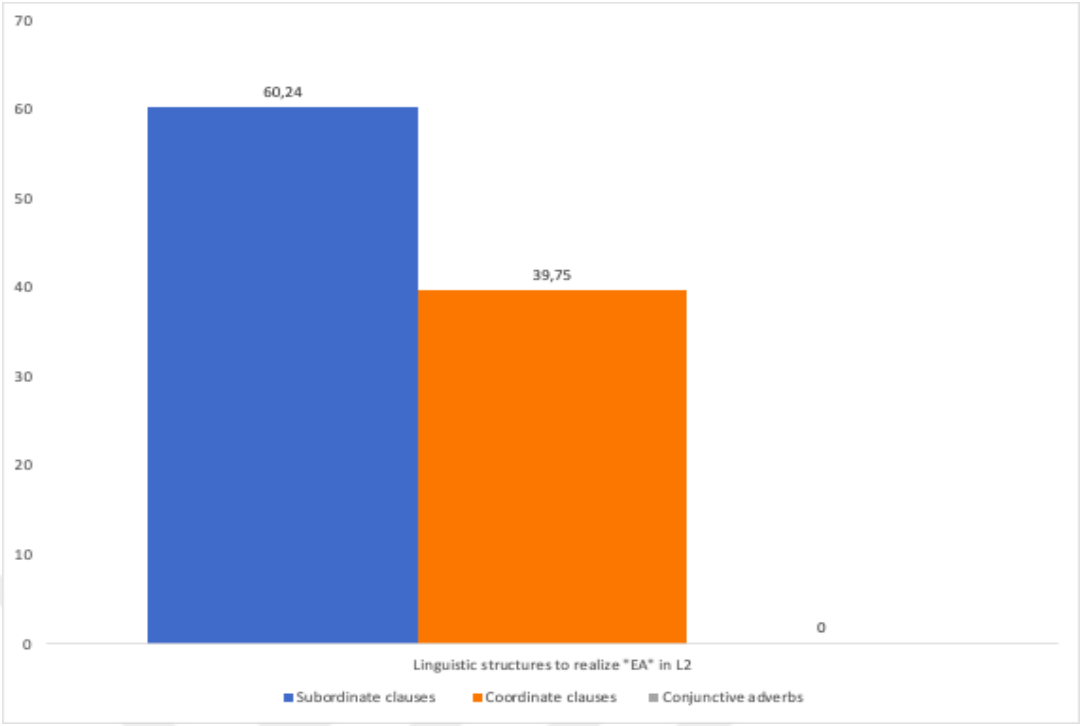

Figure 22. Distribution of the linguistic structures to realize the CDF "Explain" in L2

As can be seen, subordinate clauses occupied the biggest place in explanations in L2. As different from L1, no occasion in which conjunctive adverbs were used to give explanations was found in L2. The following excerpts show the linguistic manifestations of the CDF "Explain" in L2.

Excerpt 85
Example 1 of an explanation through subordinate clauses in L2

10	T2	Do you have any idea why the atomic radius is increasing from right to left not left to right? *Because* effective nuclear charge is increasing left to right, but this is increasing from left to right, it is kind of the opposite.

In L2, the number of occasions in which "Because" was used outnumbered when compared to the use of other structures regarding the use of subordinate clauses to give explanations. Here, T2 made a connection between the increase in the atomic radius and the effective nuclear charge by using the subordinate conjunction "Because".

Excerpt 86
Example 2 of an explanation through subordinate clauses in L2

19	T2	Nitrogen is much more stable than oxygen when the oxygen loses one electron from p orbitals. *That's the reason why* we have the second peak here. You can also apply the same rule for here... For the third row.

While talking about the peak that he drew on the board, T2 used the structure "That is the reason why" to explain the presence of that peak through the stability of nitrogen and oxygen, which was also regarded as a subordinate clause.

Excerpt 87
Example 3 of an explanation through subordinate clauses in L2

13	T2	*When* a neutral atom is converted to anions, we expect a change in size. There is a quite easy rule: Cation is always smaller than an atom which is lithium. Lithium plus one cation is smaller than an atom.

Just like L1, "When" was used to explain things in L2, too. In Excerpt 87, the expectation concerning a change in the atomic size was based on the conversion of neutral atoms into anions.

Excerpt 88
Example 1 of an explanation through coordinate clauses in L2

11	T2	Nitrogen has seven protons, and the fluorine has nine protons. Chlorine... A great negative charge is always bigger, *so* the nitrogen is larger than fluorine. Nitrogen minus one… Magnesium plus two and potassium plus two... And the charge is the same.

In this occasion, "So" was used to connect two sentences which can also be found separate from each other. The fact that negative charges were bigger was given as the reason why nitrogen was larger than fluorine.

4.4.5.3. The linguistic structures used to realize the CDF "Explain" in L3

In Physics lecture, the CDF "Explain" was the second most occurring function. As a prevalent usage, the conjunctions "So" and "That is why" were used together mostly. The following figure shows the general distribution of the linguistic structures used to realize the CDF "Explain" in L3.

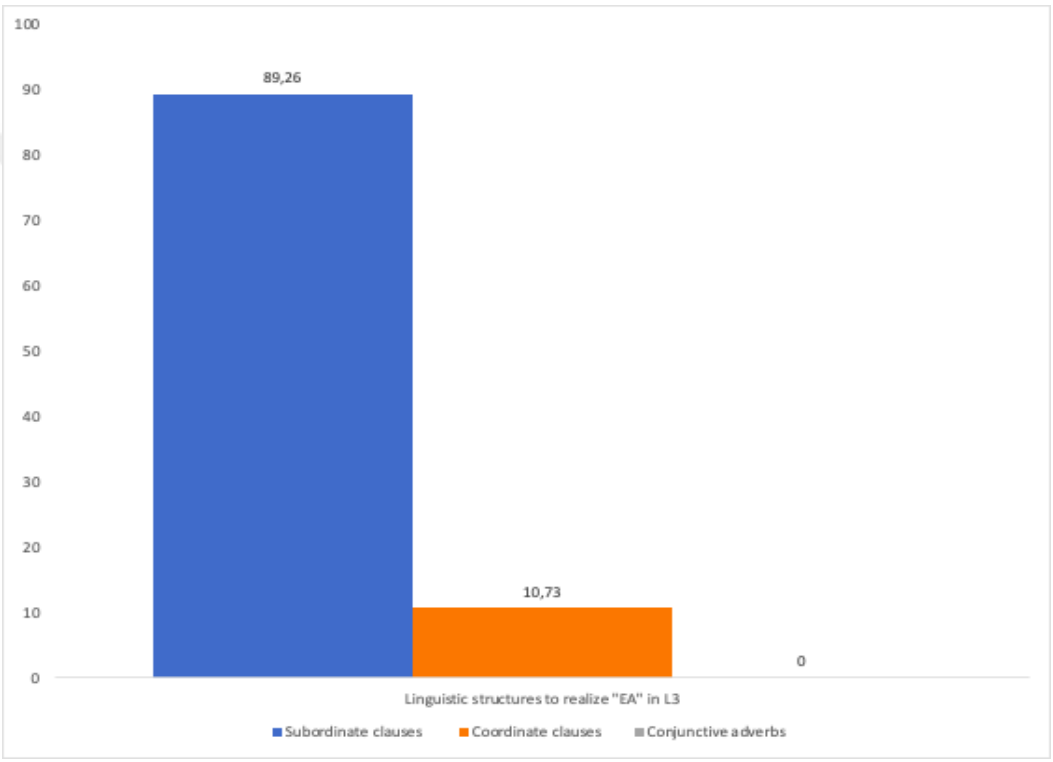

Figure 23. Distribution of the linguistic structures to realize the function "Explain" in L3

When compared to L1 and L2, the ratio of subordinate clauses in explanations was found to be higher in L3. No conjunctive adverbs were observed during explanations similar to L2. The following excerpts show the examples of linguistic structures to realize the CDF "Explain" in L3.

Excerpt 89
Example 1 of an explanation though subordinate clauses in L3

162	T3	Force is a vector quantity. The position of this point is a vector quantity *(Showing on the board)*. We are not going into detail using vector notation. Indeed, you should know that torque or force moment is a vector quantity, *because* depending on the direction of the force, the rotational direction changes. If you apply force in this direction, this is the direction of the torque, right?

As a similar pattern to L1 and L2, the use of "Because" to explain things was found to be a common phenomenon concerning the use of subordinate clauses. The change in the rotational direction was dependent on the direction of the force, which was signaled by the use of "Because" in Excerpt 89.

Excerpt 90
Example 2 of an explanation through subordinate clauses in L3

189	T3	Okay, what about this part, did you understand this? Ha? I just write down the total work in terms of the total work done by the conservative forces and total work done by the non-conservative forces, okay? I can define the potential energy from the conservative forces, *that is why* I can write down the work done by the conservative forces as Delta U, okay? The rest of it is just the total work done by the non-conservative forces.

Excerpt 91
Example 3 of an explanation through subordinate clauses in L3

56	T3	After the collision, but what is after the collision? They collide with each other. The spring is just compressed and then yes… and they... they are just separate from each other, *because of* the spring, and this spring is the linear one, *so that's why* the collision is an elastic collision.

Referring to Excerpts 90 and 91, two occasions in which the subordinate conjunction "That is why" was used can be seen. "That is why" was also prevalent in terms of giving explanations throughout L3. In the latter excerpt, it can be seen that "So" and "That is why*"* were used one after another while explaining the reason why an elastic collision occurred. Such kinds of usages were the prevalent ones in L3 regarding explanations. In these occasions, "So" was not regarded as a coordinate

conjunction because, together with “That is why”, it connected two dependent clauses which were supposed to be found together; otherwise, the meaning would be reduced.

Excerpt 92
Example 1 of an explanation through coordinate clauses in L3

55	T3	*V1 final* is *3 m/s*, right? What is V2 final? That is the question, okay. Now again, regardless of the type of the collision, linear momentum is conserved, *so* I can use the conservation of linear momentum.

As a similar finding with the previous lectures, “So” was the most common coordinate conjunction throughout L3. Here, the possibility of using the rule was explained through the term conservation of linear momentum in the example question.

4.4.5.4. The linguistic structures used to realize the CDF “Explain” in L4

In Dynamics lecture, “Explain” was the most occurring CDF type together with “Report”. The CDF “Explain” was observed 32 times in the two lectures. The following figure shows the linguistic structures used in explanations in L4.

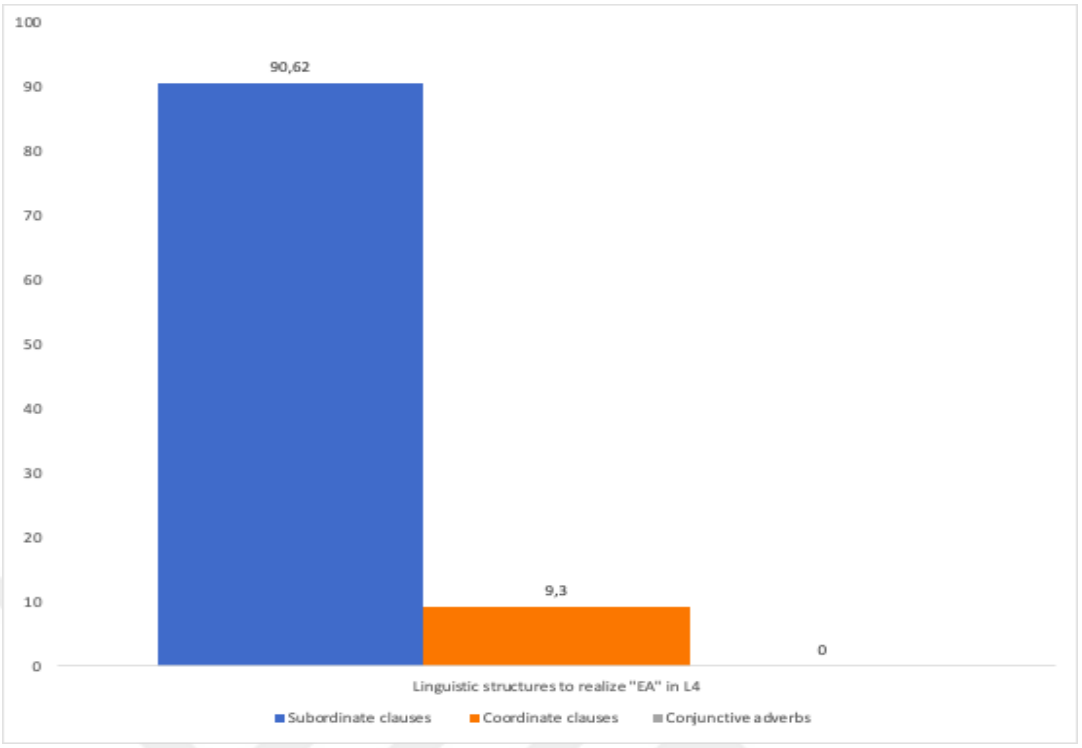

Figure 24. Distribution of the linguistic structures to realize the function "Explain" in L4

Subordinate clauses occupied more than 90% of the total explanations in L4. Coordinate clauses constituted approximately 10% of the explanations. No conjunctive adverb was observed during explanations in L4.

Excerpt 93
Example 1 of an explanation through subordinate clauses in L4

43	T3	*If* the object has only translational motion, there is no rotation. What is the angular acceleration? Zero. *If* there is no rotational motion, angular acceleration is zero.

In this excerpt, it can be seen that the condition in which the angular acceleration is zero was dependent on the object's translational motion. Therefore, the value zero was explained through the use of conditional clauses.

Excerpt 94
Example 2 of an explanation through subordinate clauses in L4

73	T3	Of course, it is rotating this way *because* there is only static friction there is no slip here, okay? The center of mass of this wheel is moving but to this one and this moment, okay? This at rest, *that is why* this force of friction at normal force and weight don't do any work.

In Excerpt 94, T3 was talking about the shapes that he drew on the board. Here, both the use of "Because" and That is why" can be seen. T3 explained the absence of a slip through the presence of static friction by using the structure "Because". Similarly, the states of force of friction and weight were explained with an object which had no movement. These two dependent clauses were connected through the subordinate conjunction "That is why".

Excerpt 95
Example 1 of an explanation through coordinate clauses in L4

101	T3	It is given to find the angular velocity of the wheel after it has rotated ten revaluations, okay? The wheel starts from rest and rolls without slipping, *so* initial kinetic energy is zero.

In Excerpt 95, the movement type of a wheel resulted in a zero kinetic energy in its initial position, which was explained through the coordinate conjunction "So". In the case of formulating those two sentences without using "So", the meaning is reduced. That was the reason why these kinds of sentences were evaluated under the title of coordinate clauses.

Generally, it can be stated that subordinate and coordinate clauses were employed by all participant lecturers while explaining something. Only T1 used conjunctive adverbs to give explanations. The following figure shows the general distribution of the preferred linguistic structures used to realize the CDF "Explain" in all observed lectures.

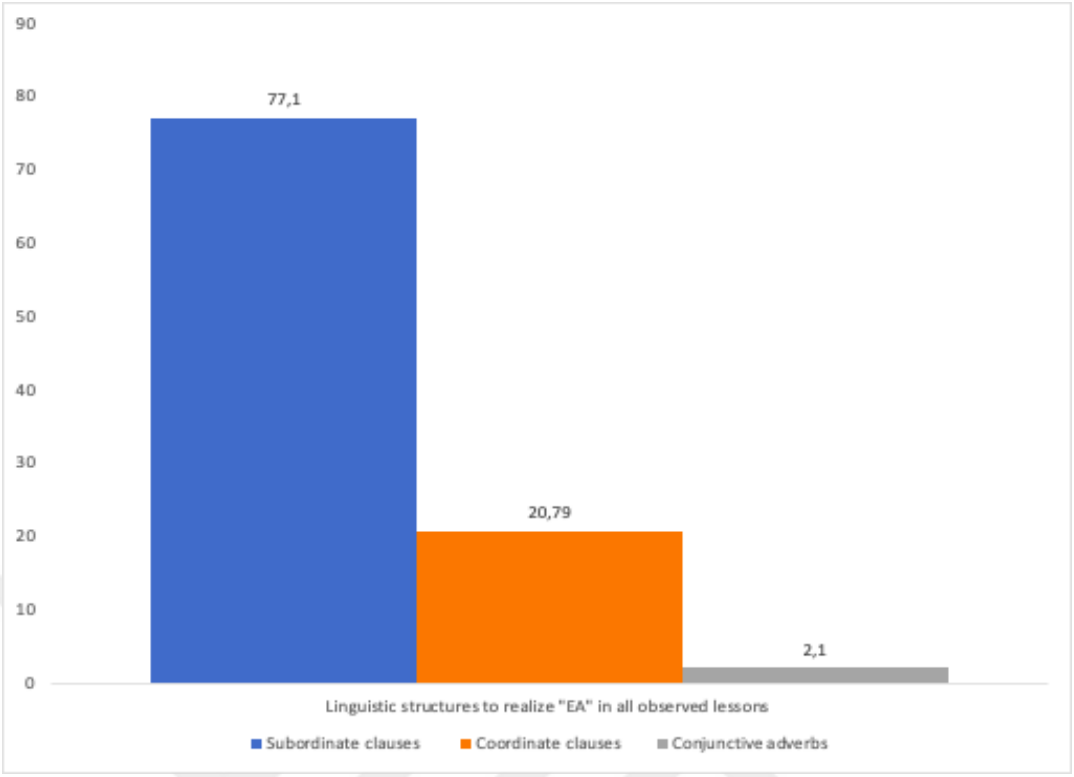

Figure 25. The general distribution of linguistic structures used to realize the CDF "Explain" in all observed lectures

As can be seen, a vast majority of the explanations in all lectures was based on subordinate clauses. Only a quarter of all coded explanations belonged to the use of coordinate clauses. Conjunctive adverbs, on the other hand, occupied the smallest place as they were only employed by T1.

4.4.6. The CDF "Explore"

This CDF type was the fifth most observed type throughout all lectures. Three fundamental linguistic patterns were detected from the analyzed data in terms of the realization of the CDF type. These were the use of modal verbs, subordinate clauses, and particular verbs (e.g., *assume, guess*, *predict*, *suppose, think,* and *say*) respectively. For T3's lectures, there was also another prevalent pattern which was the phrase "Let's say". Depending on its function, it was also evaluated as the CDF "Explore" in some contexts. Linguistic realizations of the CDF "Explore" are presented in the following sections.

4.4.6.1. The linguistic structures used to realize the CDF “Explore” in L1

This CDF type was not frequently used in the scope of departmental general chemistry lecture. Out of 589 coded CDFs, only 36 of them were “Explore”. The following figure shows the general distribution of the linguistic structures to realize the CDF “Explore”.

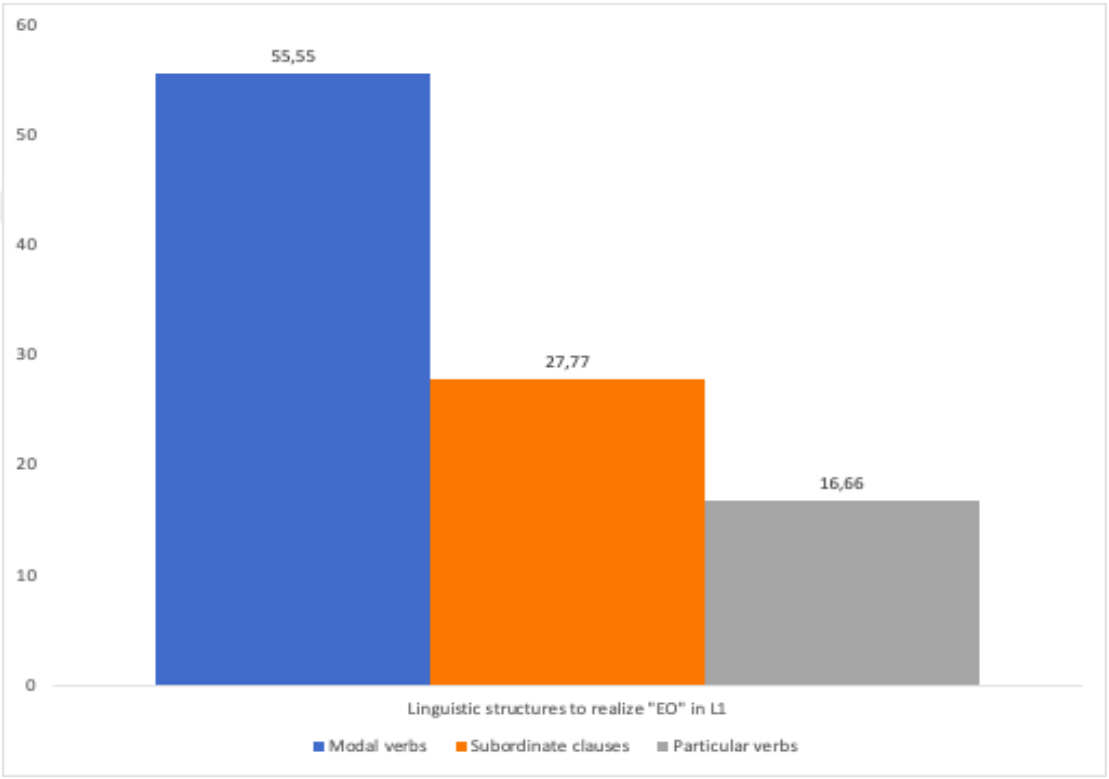

Figure 26. Distribution of the linguistic structures to realize the function “Explore” in L1

In L1, the most prevalent linguistic structure to realize the CDF “Explore” was found to be modal verbs. These modal verbs were “Might”, “Should” and “Would”. The use of “Would” was examined under the categories of both modal verbs and subordinate clauses depending on the context in which it was used. When the modal verb “Would” was used independent from a subordinate clause, which was a conditional clause in most cases, it was labelled as the use of modal verbs. However, when it was a part of a conditional clause, it was coded as the use of subordinate clauses. The following excerpts present the use of modal verbs in the realization of the CDF “Explore” in L1.

Excerpt 96
Example 1 of an exploration through modal verbs in L1

124	T1	So, this one will be expanded octet and the correct Lewis structure is like this. You *might* think shift these electrons to here because this one can have expanded octet, but in such a case, *what would be the formal charges*? For this one seven-six-two, so it will be minus one.

In Excerpt 96, the use of both modal verbs "Might*"* and "Would*"* can be seen. By using "Might", T1 showed her own assumption about the way students were thinking. The use of the modal verb "Would" is not connected to a conditional clause. That was the reason why it was evaluated as the use of modal verbs rather than subordinate clauses. By using "Would", T1 tried to create an imaginary scenario in students' mind so that they could think further.

Excerpt 97
Example 2 of an exploration through modal verbs in L1

11	T1	Carbon atoms are hybridized right? That carbon atom. Those sp2 carbon orbitals, how many of them? There are 3 of them. At a trigonal planar shape, so I *would* draw something like a flower. These are SP2 orbitals around carbon, and there is one more carbon here, which is another SP2 orbital.

Here, another usage of the modal "Would" can be observed. In this occasion, T1 talked about her own hypothetical action which was drawing a shape like a flower to illustrate a trigonal planar shape.

Excerpt 98
Example 1 of an exploration through subordinate clauses in L1

138	T1	*If you are to think* about the waves, *what would happen*? The two waves, first and second wave, *if* they are within the same phase, we mean their peaks are on top of each other, *what would be the result of the wave*?
139	S8	Kavuşurlar. Yani beraber… [TR] *(They converge. I mean, together…)*

In Excerpt 98, it can be observed that there is an occasion in which a subordinate clause and modal verbs were used together. By saying "*If you are to think about the waves"*, T1 created another imaginary situation and completed her

utterance with the hypothetical question "What would happen?". In the rest of the example, it can be seen that the same structure was repeated with another context. The mixture of a conditional clause and the question "What would happen?" was thought-provoking as students started to think and ask each other about the possible results of the imaginary scenario.

Excerpt 99
Example 1 of an exploration through particular verbs in L1

432	T1	There will be less gas molecules that will result in low density. *Assume that* there exist molar intermolecular forces in gases because they are very far apart. Because they are very far apart, they cannot attract or repel each other so we *assume* no intermolecular force for gases.

Within the scope of L1, the most preferred verb to realize the CDF "Explore" was "Assume". By uttering the phrase "Assume that…", T1 tried to encourage students to think about the possible consequences of the presence of molar intermolecular forces in gases which was something different from what they had learned until that time. There were also a few instances of the verbs "Guess" and "Suppose". However, the number of the verb "Assume" was higher than other verbs. The occasions in which the verb "Guess" was used generally consisted of utterances like "I guess you know X", which was a sort of assumption.

4.4.6.2. The linguistic structures used to realize the CDF "Explore" in L2

Within the scope of General Chemistry lecture, which is across disciplines, there were only 10 occasions in which the CDF "Explore" was observed. Regarding the use of particular verbs in explorations, the verb "Think" was used to create hypothetical situations by T2 as a different finding from L1. The following figure shows the general distribution of the linguistic manifestations of the CDF "Explore" in L2.

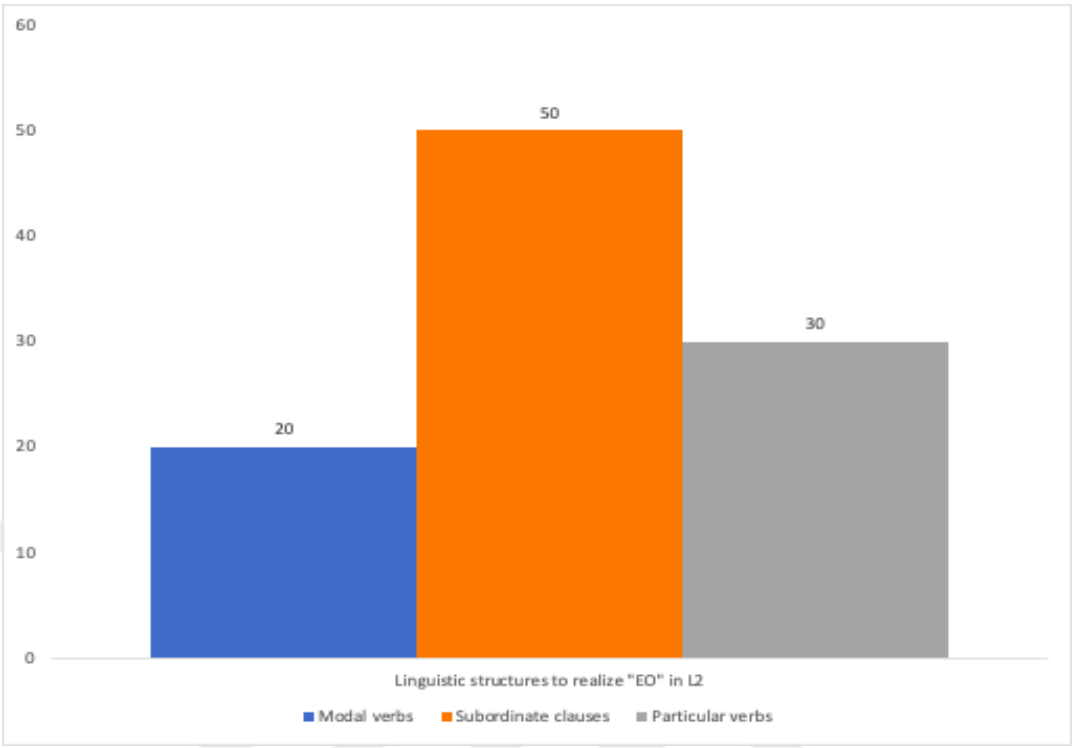

Figure 27. Distribution of the linguistic structures to realize the function "Explore" in L2

As can be seen, subordinate clauses composed half of the usages concerning the CDF "Explore" in L2. Out of 10 explorations, only two of them were the use of modal verbs. The following excerpts demonstrate the linguistic structures used to realize the CDF "Explore" in L2.

Excerpt 100
Example 1 of an exploration through modal verbs in L2

19	T2	Density of seawater is 1.1. Density of mercury is 13.6. When would a mercury barometer reach the height of 73.5 cm? By using the equation, density times height is equal seawater… Density of mercury times the height of mercury...

The use of the modal verb "Would" in this occasion serves for the creation of an imaginary situation. Because it was not accompanied by a conditional clause, this usage was evaluated as the use of modal verbs in the realization of the CDF "Explore".

Excerpt 101
Example 1 of an exploration through subordinate clauses in L2

36	T2	The pressure is 0.4 ATM. How *would* we figure out the new volume *if* a balloon has the volume of 0.5 at sea level? Which means 1 ATM and the temperature is 70 degrees. You need to do some manipulations to the ideal gas equation. You have a balloon at sea level.

In this occasion, the modal "Would " and the conditional clause "If " were used together to create an imaginary situation. T2 assumed that the volume of the balloon was 0.5 at sea level by using those linguistic patterns.

Excerpt 102
Example 1 of an exploration through particular verbs in L2

12	T2	*Think* this is like a refrigerator, put that magnet on the refrigerator. You put one piece of paper and the attraction between the refrigerator and magnet is decreasing. *Think about* this paper as a shell. This is shielding (*Showing on the board).*

In addition to the verbs like "Assume", "Suppose" and "Guess" which were observed in L1, different verbs like "Think" and "think about", were observed in the realization of the CDF "Explore" through particular verbs in L2. By uttering those verbs, T2 tried to envisage the phenomenon of shielding by encouraging students to think of it as a paper.

4.4.6.3. The linguistic structures used to realize the CDF "Explore" in L3

Out of 550 CDFs, 107 of them were the CDF "Explore" in L3. As a different finding from previous lectures, T3 tended to use the phrase "Let's say" to create hypothetical situations in which students think about the possible results of an action or equation. Rather than stating these kinds of situations through other structures, T3 preferred sentences like "Let's say this is X…", which was not actually given in questions or textbooks. Instead, T3 tried to convey the hypothetical or imaginative

situations in his mind by using this structure. Other than this, there were also instances of the use of other verbs including *assume*, *suppose* and *imagine*. Both those kinds of verbs and the phrase "Let's say" were coded under the title of particular verbs. The following figure shows the linguistic structures used to realize the CDF "Explore" in L3.

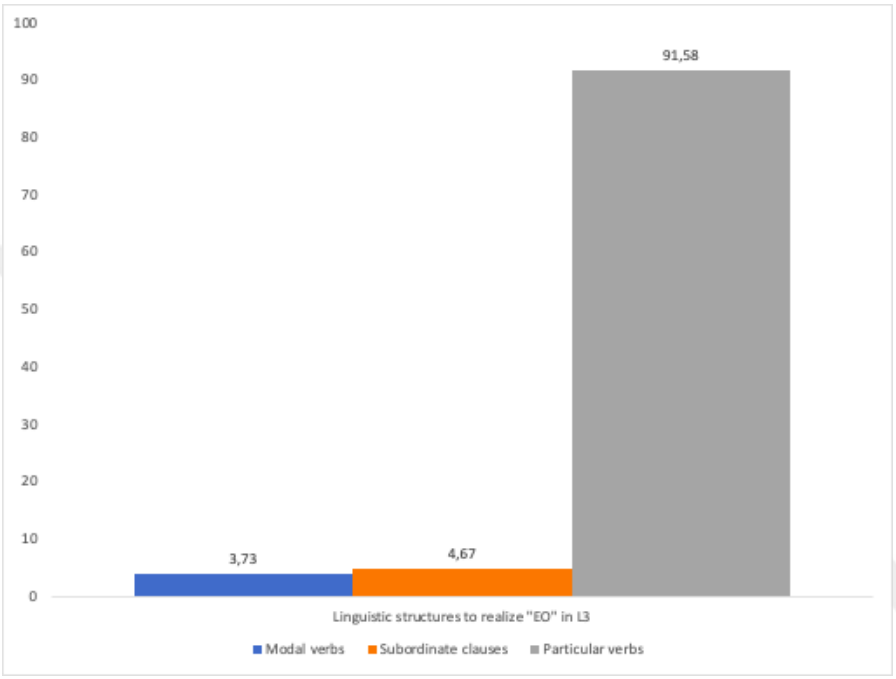

Figure 28. Distribution of the linguistic structures to realize the function "Explore" in L3

More than 90% of the instances in which the CDF "Explore" was observed were formed through the use of particular verbs including the phrase "Let's say". There were 80 occasions in which the phrase "Let's say" was used for the purpose of making explorations. Besides, other particular verbs were used 18 times. Together with the phrase "Let's say", they were observed 98 times in total. Other usages observed very rarely when compared to the use of particular verbs. The following excerpts show the linguistic manifestations of the CDF "Explore" in L3.

Excerpt 103
Example 1 of an exploration through modal verbs in L3

105	T3	Their final relative velocity is zero but, it does not mean that when the spring is compressed at maximum, it does not mean the system is at rest. *Likely it should be moving to the right,* so, but I can say that… *If* there is a maximum compression of the spring, they have a common velocity, right? That means, they just stick together. Understood?

In Excerpt 103, the use of a different modal verb, "Should", was observed. By using that modal, T3 tried to convey his assumption regarding the movement of the spring. Besides, the adverb "Likely" supported the possibility of realization of that assumption, too.

Excerpt 104
Example 1 of an exploration through subordinate clauses in L3

98	T3	Two dimensional collisions. Okay, so far, we have learnt one dimensional collision that means two particles just had a central collision. *What about if* the two objects are moving along different lines before and after the collision? M1 m2 is moving, V1 initial and V2 *(Showing on the board),* so you *might* know this angle, so this is the collision centre. For example, after the collision, *let's say* M1 is moving with a velocity of V1 finaland M2 final, they are vectors, right?

In Excerpt 104, a different linguistic structure, "What about if...?", regarding the use of subordinate clauses to make explorations was observed. This structure functions similar to the mixture of the structures "Would" and "If" in terms of prompting students to think further concerning the imaginary situation. At this point, T3 wanted students to reflect on a hypothetical scenario in which two imaginary objects moving along different lines before and after the collision.

Excerpt 105
Example 1 of an exploration through particular verbs in L3

33	T3	So, linear momentum must be conserved, okay? *Let's say* this is positive X direction after he released the arrow. The arrow is moving to the right. *Let's say* this is the final one, our initial is fifty meters per second, right? Okay, what is the mass of the arrow?

The phrase “Let’s say” was quite prevalent in L3 in terms of realization of the CDF “Explore”. By using this phrase, T3 created imaginary scenarios in which students could think of different situations. For instance, in Excerpt 105, T3 created a situation regarding the direction of the released arrow. Then, he gave hypothetical numbers about the distance covered by the arrow by using the very same structure, “Let’s say”.

Excerpt 106
Example 1 of an exploration through particular verbs in L3

108	T3	During the… Okay, first of all... You can just *imagine* that there is an impulsive force on the car during the collision, right? Okay, good. Now you can talk about the impulse on the car using this impulsive force from T1 to T2 or initial to final. In the question, it is said that this force *could be assumed* constant? Now, you can say that this is F vector impulsive force times delta T.

In this occasion, both the use of a modal verb “Could” and a particular verb “Assume” can be observed. T3 paraphrased the question by using those structures so that students could work on different numbers to internalize the way of solving those kinds of problems.

4.4.6.4. The linguistic structures used to realize the CDF “Explore” in L4

There was only one occasion in which the CDF “Explore” was observed in the scope of dynamics lecture. That is why, no visual regarding the distribution of the linguistic manifestation of the function was provided. The following excerpt shows that occasion.

Excerpt 107
Example 1 of an exploration through particular verbs in L4

28	T3	It is too dimensional motion. Right, it is too dimensional motion on a plane on a surface. But *I think* you just wanted to say translational motion, right? So, if an object is moving among a line without any rotation about any access, this motion is called translational motion. OK?

Just like L2, the verb "Think" was used in L4 as well for the purpose of making explorations. By uttering the phrase "I think", T3 conveyed his assumption regarding students' background knowledge, which was labelled as the realization of the CDF "Explore".

In general, the CDF "Explore" was realized mainly through the use of modal verbs, subordinate clauses, and certain verbs. The following figure shows the general distribution of the function based on observed linguistic patterns in all observed lectures.

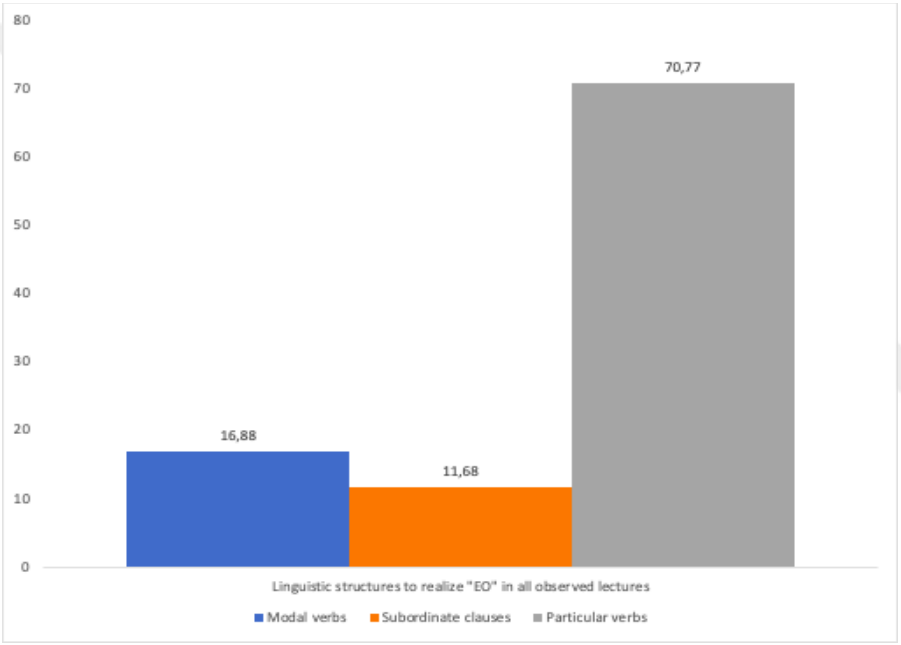

Figure 29. The general distribution of linguistic structures used to realize the CDF "Explore" in all observed lectures

As can be seen, even though modal verbs and subordinate clauses occupied bigger places in individual lectures, the use of particular verbs has the biggest place in the total number of occurrences of the CDF "Explore". The use of particular verbs, especially the structures formulated through the phrase "Let's say", were dominant in the physics lecture. That was the reason why the use of particular verbs was found to be more prevalent than others concerning the general distribution.

4.4.7 The CDF "Report"

This CDF type was the third most observed one throughout all lectures. It was used in a number of occasions with three main purposes which are summarizing, referring to a previous topic, and presenting facts or research findings. Therefore, it was not possible to find a general linguistic pattern for the realization of this CDF type. As Dalton-Puffer and Bauer-Marschallinger (2019) did in their study, the underlying communicative potential of the function was searched and not the occurrence of any particular keyword was focused. After the communicative intention of the CDF "Report" were found out, preferred linguistic realizations are presented through excerpts under the related function. The purposes of occasions in which the CDF "Report" was used in each observed lecture are presented in detail in the following sections.

4.4.7.1. The role of the CDF "Report" in L1

The CDF "Report" was observed 63 times in L1. It consisted approximately 10% of total number of coding in the lesson. Regarding the CDF "Report", T1 frequently referred to her previous utterances or topics that she covered. By this way, she could encourage students to link their previous learning to the upcoming ones. There were also times when T1 summarized the previously learned topics and presented general facts or research findings, which were all coded under the title of the CDF "Report. The following figure shows the purposes of occasions in which the CDF "Report" was used in L1.

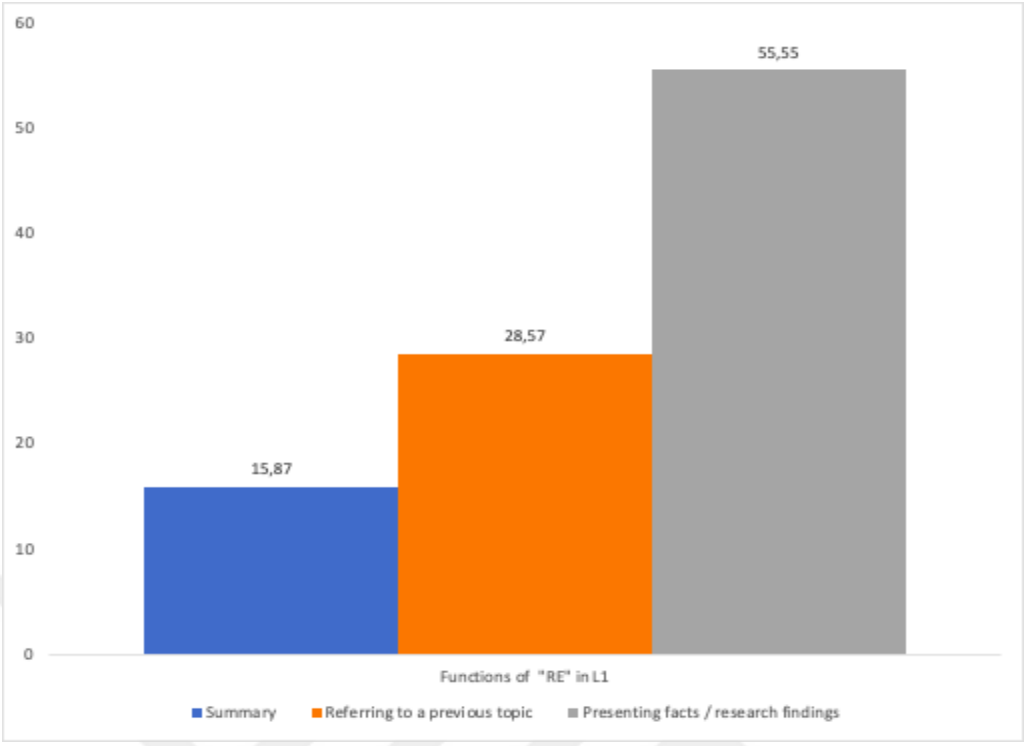

Figure 30. The functions of "Report" in L1

As can be seen, the sentences which have an informative function occupied more than half of the coding of the CDF "Report". An example of such usages is shown in the Excerpt 108.

Excerpt 108
Example 1 of the CDF "Report" in presenting facts or research results in L1

127	T1	All electrons are paired in terms of magnetism. What does it tell me? Is it paramagnetic diamagnetic?
128	Ss	Diamagnetic.
129	T1	Yes. Diamagnetic. It is not affected by the electrostatic field, right? However, *experiments show that oxygen is not diamagnetic.* It is paramagnetic, which means that it should have unpaired electrons.

In Excerpt 108, an occasion in which T1 referred to the results of experiments to state that oxygen was actually paramagnetic, not diamagnetic. By stating this fact, T1 gave a deeper information about the chemical structure of the molecule oxygen, which was regarded as the realization of the CDF "Report".

Excerpt 109
Example 1 of the CDF "Report" while referring to previous topics in L1

152	T1	This one will be stable because of the bond order. This one has a smaller bond order.
153	S2	Hocam peki ½ demiş ya orada. O nasıl bir bağolacak. Yarım bağ gibi birşey mi? [TR] *(Teacher, it says ½ over there. What kind of a bond would it be? Is it like a half-bond?)*
154	T1	*We have talked about resonance. Do you remember?* Sometimes, the bonds can be in between the double and the single bond. Do you remember the resonance theory?

When one of the students asked a question regarding the chemical bonds, T1 referred to the topic that she told earlier to activate the student's schema regarding the topic "Resonance" which was about chemical bonds.

Excerpt 110
Example 1 of the CDF "Report" while summarizing in L1

2	T1	So, *in the previous chapter, we have seen how the electrons are arranged in an atom*, right? Once these electrons are arranged in an atom, actually they show similar properties.

In Excerpt 110, T1 made a quick summary of the previous chapter in which she talked about the arrangement of atoms. Those kinds of utterances tended to occur at the beginning of the lectures because T1 tried to make a connection between the previous and upcoming topics so that students could grasp the content better.

4.4.7.2. The role of the CDF "Report" in L2

The CDF "Report" was used 57 times, which constitutes 7.3% of total number of coding in L2. Its role and distribution are quite similar to those of L1. The following figure shows the distribution of the role of the CDF "Report" in L2.

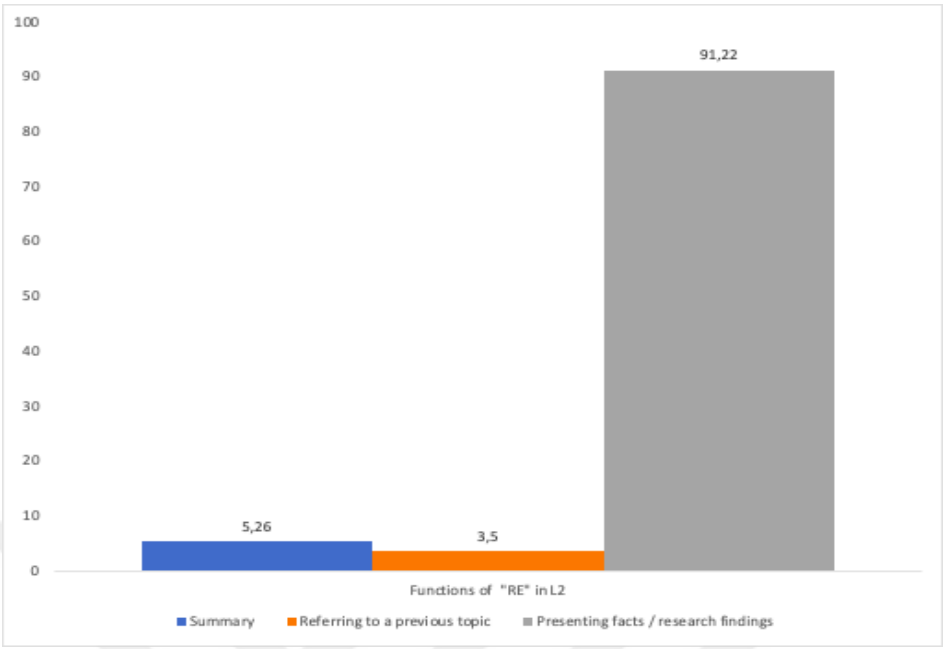

Figure 31. The functions of "Report" in L2

Presenting facts and research/experiment results constitute the biggest part of the roles of the CDF "Report" in L2, followed by summaries and referring to previous topics. The following excerpts show the occasions in which the CDF "Report" was used in L2.

Excerpt 111
Example 1 of the CDF "Report" in presenting facts or research results in L2

8	T2	*Some scientists say* light has a particle character and some others says light has a wave character, and *Einstein says* the light has both. Light has both wave and particle matter.

In this excerpt, T2 conveyed the utterances of some scientists and particularly that of Einstein's. Those kinds of utterances were regarded as the presentation of facts. Therefore, they were labelled as the realization of the CDF "Report".

Excerpt 112
Example 1 of the CDF "Report" while referring to previous topics in L2

27	T2	I hope you can understand why the valence theory, hybridization and molecular orbital theory or atomic orbitals are important. *I said many times* valence electrons determine the reactivity.

The verb “Say” was common in the realization of the CDF “Report” while referring back to a previous point. Phrases like “As I said” were prevalent in this regard. In Excerpt 112, T2 uttered the statament “I said many times”. Through such an utterance, T2 tried to emphasize the importance of valence electrons because those were among the key parts of the following topic in that lesson.

Excerpt 113
Example 1 of the CDF “Report” while summarizing in L2

24	T2	Dalton's law of partial pressure, *we have learned* a lot about ideal gases and some of them. *Up until now, we have described* individual gases, not the combination of gases.

By uttering the statements “We have learned” and “Up until now, we have described”, T2 summarized what they did until that time to wrap up the topic so that he could make a clear beginning to the next topic.

4.4.7.3. The role of the CDF “Report” in L3

In the Physics lecture, the CDF “Report” was observed 41 times, which constitutes approximately 13% of total number of coding in L3. The distribution of the role of CDF “Report” is slightly different than that of L2, the General Chemistry lecture (across disciplines). The following figure illustrates the distribution of the role of the CDF “Report” in L3.

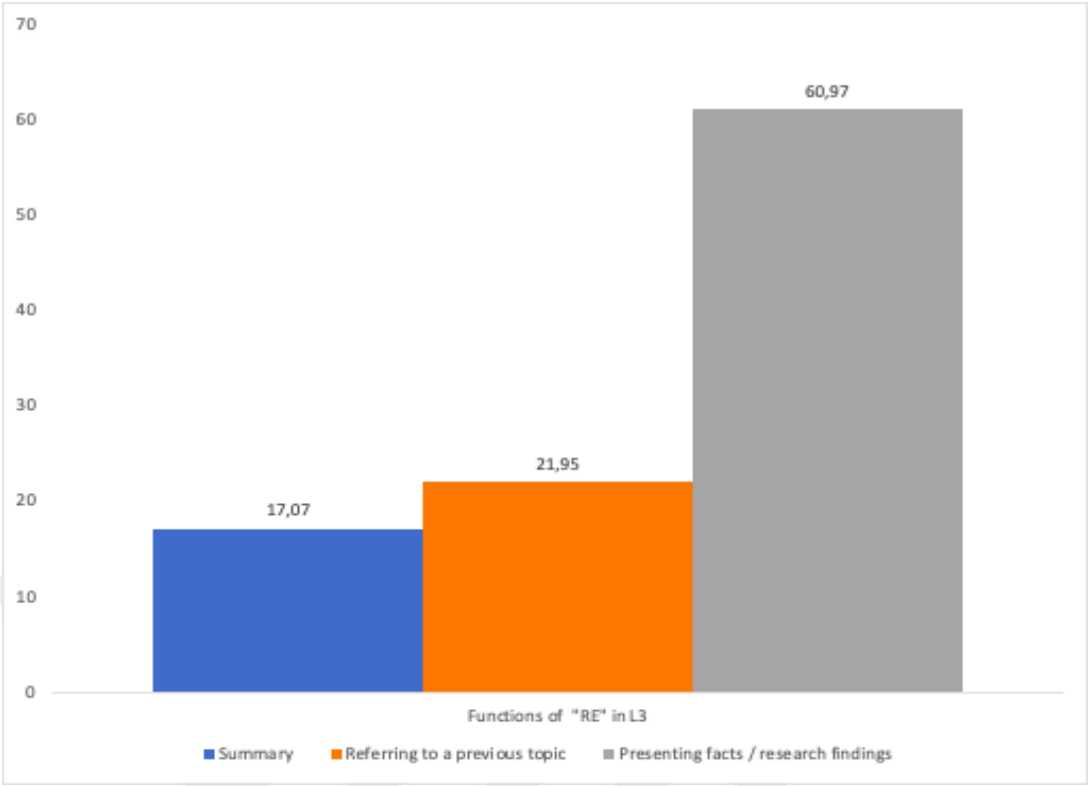

Figure 32. The functions of "Report" in L3

It can be observed that presenting facts and research/experiment results was the main role of the CDF "Report" in L3, too. However, the other roles were included as well. The following excerpts present the occasions in which the CDF "Report" was observed in L3.

Excerpt 114
Example 1 of the CDF "Report" in presenting facts or research results in L3

54	T3	This device… *(Showing on the board)* This is a laser device and its lens, okay? The laser just hits this part, okay? Then, it takes the information from this part, some electronic part, and convert this information to the sound so you can listen to music

In Excerpt 114, T3 gave information about the laser device and its functions. Because of the informative content found in the utterance, this occasion was labelled as the CDF "Report".

Excerpt 115
Example 1 of the CDF "Report" while referring to previous topics in L3

22	T3	*As I said*, it is hard to find force as a function of time within a very short time interval. Okay, but you can easily measure the initial and final velocity of the object so you can find the change in the linear momentum. Then, you can get the impulse.

"As I said" was a prevalent linguistic pattern across all observed lectures regarding the realization of the CDF "Report" while referring to a previous point. In this excerpt, T3 tried to remind the students of a previously mentioned point, finding force as a function, to make a connection to the next step, which was finding the initial and final velocity.

Excerpt 116
Example 1 of the CDF "Report" while summarizing in L3

98	T3	Thank you so much. Two dimensional collisions. Okay, *so far, we have learnt one dimensional collision* that means two particles just had a central collision.

The linguistic pattern "So far we have learnt/talked about" was frequently used in the realization of the CDF "Report", especially for summarizing. In this occasion, T3 talked about the core meaning of the recently discussed topic, which was one dimensional collision, to make a summary so that students could internalize the topic better.

4.3.7.4. The role of the CDF "Report" in L4

This CDF was observed 31 times in the Dynamics lecture. The following figure shows the functions of the CDF "Report" in L4.

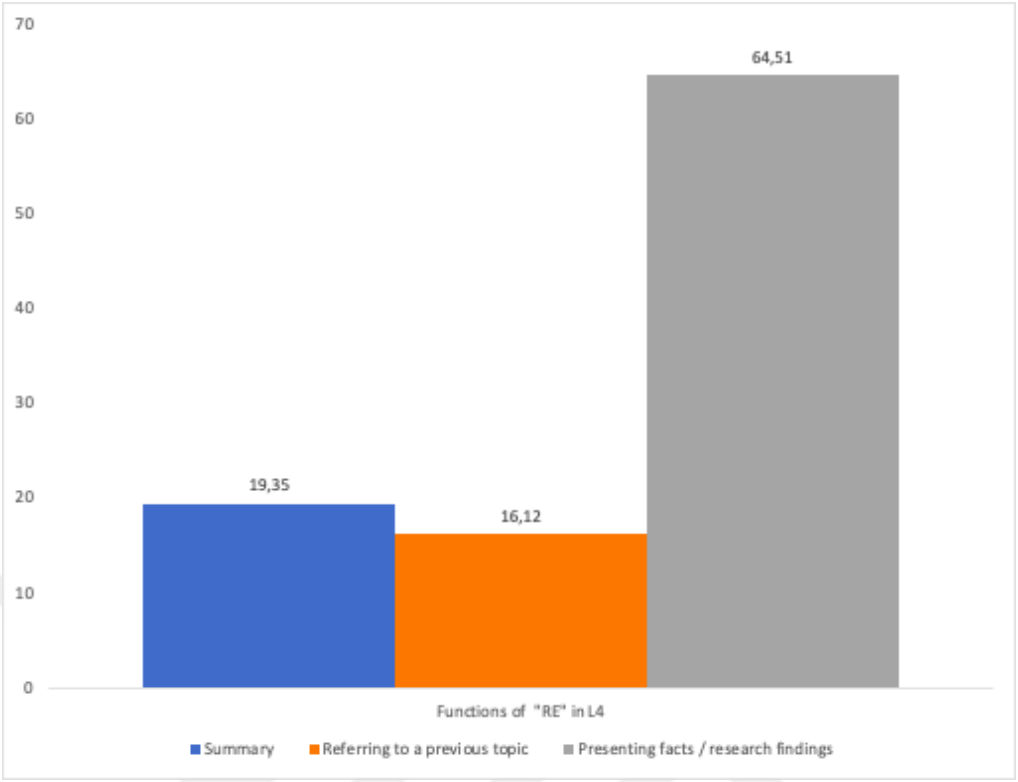

Figure 33. The functions of "Report" in L4

As can be seen, the CDF "Report" was mostly used by T3 to present facts or explain some research findings. The following excerpts show the actual occasions in which the CDF "Report" was used in L4.

Excerpt 117
Example 1 of the CDF "Report" in presenting facts or research results in L4

6	T3	Do you remember the parallel access theorem, right? Generally, we just calculate the mass moment of inertia and get an access through the centre of mass G, but if you need to calculate mass moment of inertia about another access that is unparalleled to the access through the centre of mass, you need to use this theorem: Parallel access theorem.

In Excerpt 117, it can be observed that T3 conveyed the facts about the parallel access theorem. Indeed, he talked about the basic tenets of the theory which was examined under the title of the CDF "Report" due to its informative function.

Excerpt 118
Example 1 of the CDF "Report" while referring to previous topics in L4

3	T3	*I remember I asked* you to memorize the mass moment of inertia for some specific geometry of the objects.

In Excerpt 118, T3 tried to activate students' schema about the concept of mass moment of inertia by using the italicized phrase. For these kinds of referential utterances, T3 generally used linguistic patterns like "Do you remember?", and "As I said".

Excerpt 119
Example 1 of the CDF "Report" while summarizing in L4

2	T3	*We have just reviewed* the equation motion kinematic equation for the constant acceleration, right? I just put down the kinematic equations for the linear motion, and then write down the kinematic equations for the rotational motion.

By saying "We just reviewed", T3 aimed to remind the students that he had just made a summary regarding the previous topic. In the rest of the example, it can be seen that he summarized what he did in that review part to wrap up the recent topic.

Teachers' general tendency to employ the CDF "Report" was mainly based on three functions: (i) making summaries, (ii) referring to a previous point and (iii) talking about facts or research/experiment findings. The following figure illustrates the general distribution of the function of the CDF "Report" in all observed lectures.

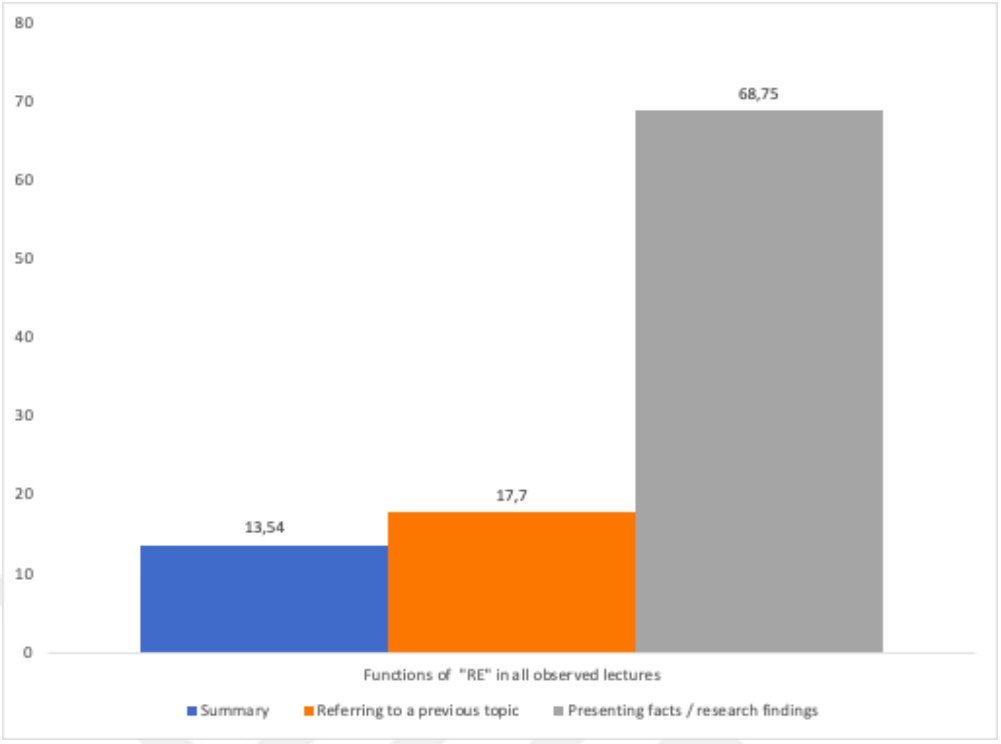

Figure 34. The functions of the CDF "Report" in all observed lectures

As can be seen from the figure, the function of presenting facts or research findings was found to be the most referred function in all observed lectures. This function was mainly observed in the occasions when the teachers were talking about experiment results, tenets of chemical and physical rules and quotes from famous scientists.

4.5. THE WAY KEY COMPETENCES ARE MET THROUGH THE USE OF COGNITIVE DISCOURSE FUNCTIONS

For the last research question, the way some key competences, or learning outcomes, of the observed lectures are met through teachers' use of cognitive discourse functions was examined. Such kind of an analysis was inspired from Doiz and Lasagabaster's study (2021). In that study, three basic competences regarding history classes were targeted and the development of those competencies were analyzed based on teachers' use of cognitive discourse functions. The same method was applied here. Therefore, how the selected learning outcomes were reached through the participant teachers' use of cognitive discourse functions was

investigated. In the framework of this analysis, only the competences related to cognitive discourse functions, were chosen and examined accordingly. Both of the observed general chemistry lectures were based on the shared learning outcomes provided by the institution. That is why those lectures were examined together in accordance with those competences. For Physics and Dynamics classes, learning outcomes were provided separately. Therefore, the analysis of those competences was done individually.

Regarding the common linguistic patterns of in the achievement of the key competences, some basic structures were found, and those occasions were shown in bold in the following excerpts. In general, whether the selected competences were achieved or not was deduced from the content of the analyzed utterances.

4.5.1. Competences of general chemistry lectures

There were a bunch of different learning outcomes regarding the General Chemistry lectures. Two of them were selected since they were found to be related to the construct of cognitive discourse functions. Those are as follows:
The students who completed this course gain the following competencies:

> **Competence 1**- *Have knowledge of the scope of modern chemistry, its methodology and application and improve their capability to describe the physical world.*
> **Competence 2**- *Define basic chemical terms and rules both theoretically and practically.*

4.5.1.1. Competence 1

With respect to Competence 1 (i.e., *Have knowledge of the scope of modern chemistry, its methodology and application and improve their capability to describe the physical world*), both teachers mostly made use of the CDFs "Define", "Describe" and "Report". Regarding the application of modern chemistry, both general chemistry teachers employed a number of definitions, and process

descriptions through which they could give information about particular processes. The following excerpts show two examples of process descriptions which are in line with Competence 1 in terms of the application of modern chemistry.

Excerpt 120
Example 1 of a process description with regard to Competence 1 in L1

69	T1	Here, in this representation, we have different shapes for these 2 bonds. This is the line representation of any organic molecule. *Normally, in organic chemistry, we use line representation for molecules. For instance, for this methane,* ***we do not represent carbon, but we put them here like this*** *(Showing on the board).*

T1 constantly emphasized the importance of visualization of chemical molecules throughout her lectures. In Excerpt 120, T1 gave information regarding line representations of organic molecules. While doing this, she made a process description. There were a number of occasions like this in which T1 described the steps of drawing chemical compounds by showing them on the board. She talked about concepts like Lewis structure and line representations to draw the structure of chemical molecules and demonstrated the actual implementation on the board. That is why, this occasion was regarded as a process description. These kinds of usages were prevalent in both Chemistry lectures (i.e., L1 and L2), which constituted a vast majority of process descriptions in those lectures.

Excerpt 121
Example 1 of a process description with regard to Competence 1 in L2

16	T2	*You can find the mass of the ionic compounds. The geometric analysis. Not about the whole identity of the molecules.* ***The first step is*** *to dissolve the unknown substance in the water. You have water and a beaker. Just pour the water into the beaker and dissolve it* ***then*** *react the unknown substance with the known one to precipitate*. Have you run the experiment in the lab about this?
17	S2	Kind of.

In Excerpt 121, T2 talked about a process, which was a particular experiment concerning the mass of ionic compounds. In both General Chemistry lectures, experiments played a crucial role. The lectures that were observed in the scope of

this study were the theoretical part of the lessons. Furthermore, there were practical parts in which students could run actual experiments with the help of research assistants. Therefore, both teachers frequently referred to experiments in terms of both their results and applications. With regard to applications of experiments, T2 gave detailed information about its implementation like dissolving the unknown substance in the water. These kinds of utterances were in line with the aim of the Competence 1 in terms of having knowledge about application of modern chemistry. This occasion was labelled as a process description because T2 used the sequencer phrases "The first step" and "Then" to talk about the steps of the experiment, which made it a process description.

Excerpt 122
Example 1 of a physical description with regard to Competence 1 in L1

432	T1	These are the states of matter, but as chemists, we generally use phases instead of states, okay? Phase or state (.). These will be separated with a well-defined boundary. Here is an example. *If you ever see ice floated on the water, we can talk about 2 phases. One phase is the ice that is in its* ***solid phase****, and it is well separated from its* ***liquid phase,*** *which is water, so we use phases instead of states here.*

To talk about the phases of matters, T1 referred to a situation which was observable in the outer world (i.e., *ice floated on the water*) in Excerpt 122. Giving examples from the real and observable world was an approach frequently employed by T1 which supports Competence 1, too. Thanks to those kinds of examples, students could improve their ability to describe the physical world, which were done primarily through the use of physical descriptions by T1. The reason why this utterance was regarded as a physical description was that the words "Liquid" and "Solid" were about the physical state of the given chemical compound, which made it a physical description.

Excerpt 123
Example 1 of a reporting and structural description with regard to Competence 1 in L2

7	T2	*The energy is emitted or absorbed by quantum. It is like…You cannot withdraw 16 liras from an ATM, right? You can draw 5, 10, 20, 50, 100 liras.* Energy is like that. *It is in discrete units.*

In Excerpt 123, T2 made a simile regarding the nature of energy. He compared the structure of energy with ATM machines which students know in their daily lives. By this way, students could understand the discrete units of energy. Moreover, they had the opportunity to describe the physical world more easily thanks to such similarities made by T2. The function of the sentences "The energy is emitted or absorbed by quantum", and "You cannot withdraw 16 liras from an ATM, right? You can draw 5, 10, 20, 50, 100 liras." was about delivery of facts, which was evaluated as an occasion of the CDF "Report". The utterance "It is in discrete units." referred to the structure of the term energy, which was labelled as a structural description.

Excerpt 124
Example 1 of a description and reporting with regard to Competence 1 in L1

53	T1	*The approach that studies the molecular geometry based on valence shell electrons* ***is called*** *valence shell electron pair repulsion theory or in short, VSEPR theory. It comes from the repulsion of the electron bonds. This theory helps us to predict the geometry of molecules from the electrostatic repulsion between electron pairs.*

In Excerpt 124, T1 firstly introduced the term "Valence shell electron pair repulsion theory" by employing the CDF "Define". While defining, she used relative clauses. Then, she talked about the tenets of valence shell electron pair repulsion (VSEPR) theory, and this was an occasion in which she presented some facts. Therefore, this utterance was regarded as an occasion of the CDF "Report". Firstly, she introduced the theory and its fundamentals. Then, she talked about the way students could benefit from it, which was predicting the geometry of chemical molecules. Therefore, this utterance both implies the general knowledge about modern chemistry and its methodology, which is suggested by Competence 1.

Excerpt 125
Example 1 of a reporting with regard to Competence 1 in L2

69	T1	So, we can combine these 3 laws. Boyle, Charles and Avogadro, we can end up with the ideal gas equations. *The sum of gas laws… The first one is Boyle's law. Pressure is inversely proportional to volume, and the temperature and the number of moles is constant. The second law, Charles's law, the volume is directly proportional to temperature, and the pressure is directly proportional to volume, in case moles and pressure or volumes are constant. The last one is Avogadro's law. Volume and moles are proportional. You can easily see that if you decrease the volume, you are increasing the pressure (Showing on the board).*

In Excerpt 125, T2 made a summary regarding laws of gases, whereabout he talked earlier. He initially gave general information about the nature of those laws, which was regarded as the CDF "Report" because they were about general facts. Then, he talked about the methodological part by showing the applications on the board. He said that volume and pressure were inversely proportional because when volume was decreased, pressure was automatically increased. This occasion also supported Competence 1 because it was about the general knowledge about modern chemistry and the expressions like "Directly/ inversely proportional" were about the methodological or practical part. This occasion was regarded as an example of the CDF "Report" because T2 expressed some facts regarding basic chemical rules.

In brief, it can be observed that both teachers gave information about the nature of modern chemistry mainly with the use of the CDF "Report". Then, they made some descriptions (i.e., *physical*, and *structural*) regarding the physical reflections of the terms they discussed in the physical world. Regarding the applications and methodology of modern chemistry, they employed a number of process descriptions to make students familiar with the practical parts of the things they told.

4.5.1.2. Competence 2

In Competence 2 (i.e., *Define basic chemical terms and rules both theoretically and practically)*, it was suggested that students were supposed to have the ability to define fundamental chemical terms and rules both in theory and practice. With respect to Competence 2, both teachers frequently employed the CDFs "Define" and "Describe" in their lectures. The following excerpts show the examples of the utterances which are in line with the requirements of competence 2.

Excerpt 126
Example 1 of a definition with regard to Competence 2 in L1

107	T1	Here, when you draw such a thing, it behaves like a slot. It is the enthalpy of vaporization over gas constant, which is something constant. *This* ***equation is known as*** *Clausius-Clapeyron* ***Equation that relates the temperature with the vapour pressure*** *and also you can find the enthalpy of vaporization from there.*

In Excerpt 126, T1 firstly defined the term "Clausius-Clapeyron Equation" by using a relative clause to add more details. Then, she made a comment about the practical usage of the equation to inform the students about the areas in which they could make use of it. Therefore, she both defined the chemical equation theoretically by using passive and subordinate structures and then, she gave information about its practical usage. Therefore, this is an example utterance which supports Competence 2.

Excerpt 127
Example 1 of a definition and functional description with regard to Competence 2 in L1

126	T1	The other hydrogen 1 electron in is 1S atomic orbital. *These* ***are the things that you see on the outer side*** *(Showing on the board).* ***They are the atomic orbitals****,* okay? ***They are the pure orbitals which we use to explain valence orbital theor****y*. However, in molecular orbital theory, *these two atomic orbitals* ***can combine*** *to form molecular orbitals.*

In Excerpt 127, T1 initially defined the term “Atomic orbitals” by using various linguistic structures like relative clauses. After she defined the chemical term, she continued her utterance with the practical function of the atomic orbitals. The statement “They are the pure orbitals which we use to explain valence orbital theory” was regarded as a definition through the use of relative clauses. That definitive utterance gave insights about the function of atomic orbitals, which was its use in the explanation of valence electron theory. T1 also continued to give definitions at the rest of her utterance. The sentences “They are the atomic orbitals” and “They are the pure orbitals which we use to explain valence orbital theory.” are examples of definitions, too. Then, an occasion which was coded as a functional description was observed. “These two atomic orbitals can combine to form molecular orbitals”. This statement also showed how atomic orbitals interact with each other in practice, which was regarded as a functional description because it was about the functional capability of the given orbitals. These all are in line with the nature of Competence 2 in terms of defining chemical terms both theoretically and practically.

Excerpt 128
Example 1 of a definition with regard to Competence 2 in L2

9	T2	*The Hund’s Rule **tells** the electron is added to each generation before the others are added.If you generate the same energy level for orbitals, you need to fill each electron orbital first.*

In Excerpt 128, T2 introduced “Hund’s Rule” by defining its tenets within a theoretical framework. It is an example of a definition through the verb “Tell”. Then, he made a comment about its practical application by stating what the students were supposed to do to follow the requirements of the rule.

Excerpt 129
Example 1 of a definition and functional description with regard to Competence 2 in L2

36	T2	You can use the titration for acid-based reactions *which **is also known as** hydrogen transfer reactions. Hydrogen can be used for the analysis of acid-based reactions.*

T2 firstly defined the term “Acid-based reactions” by introducing its other name. This occasion was regarded as a definition through use of passive voice structure. He then said that acid-based reactions could be analyzed practically with the use of hydrogen.

As can be seen, teachers firstly defined the chemical terms or rules by using various linguistic structures in all excerpts. Then, they made comments about their use or application in practice. Therefore, they both defined the terms in theory and practice.

4.5.2. Competences of the physics lecture

For the Physics lecture, there were again various competences. Two competences were found to be in line with the cognitive discourse functions. Those competences are:

At the end of the course students will be able to:

Competence 1-*Define work and energy theorem*

Competence 2- *Define the dynamics and kinematics of rotational motion*

4.5.2.1. Competence 1

With regard to Competence 1 (i.e., *Define work and energy theorem*), T3 employed a range of CDFs. Indeed, the competence was based on the action “Define”, but actually the term “Work and energy theorem” was too complicated to be delivered only through the CDF “Define”. Furthermore, the students had already been familiar with the terms because the observation period took place towards the middle of the semester. Therefore, T3 needed to employ other CDFs to give detailed information about the terms rather than just making use of the CDF “Define”. Therefore, he made use of the CDFs “Define”, “Describe”, “Explain” and “Report” while trying to meet the requirement of Competence 1. The following excerpts illustrate some exemplary utterances in which Competence 1 was achieved.

Excerpt 130
Example 1 of a definition and reporting with regard to Competence 1 in L3

16	T3	Now, let's move on the theory, *work and energy theory*. So, if this is the total work on the object *(Showing on the board)*, what is the right side of this equation? Other than this expression… *It is the change in*
17	S2	*what?*
18	T3	*Hmm…Energy?Changing kinetic energy,* right? Delta kinetic energy…This is the basic idea of the potential energy. *Now, let's move on back to work and energy theory. One more time,* ***it means****, regardless of type of the force, the total work done on the object equals the change in the kinetic energy.* ***So far, we have reviewed work and energy theory****. Now chapter 8...*

In Excerpt 130, T3 firstly introduced the term "Work and energy theory". To activate students' schemata regarding the term, T3 referred to the drawing on the board and asked some questions about it like "What is the right side of this equation?" and "It is the change in what?". After he elicited the desired answer from one of the students, he continued to focus on the term to be defined. The utterance "One more time, it means, regardless of type of the force, the total work done on the object equals the change in the kinetic energy" was regarded as the definition of the term "Work and energy theory". The definition was done through the use of the verb "Tell". Then, he employed the CDF "Report" by saying "So far, we have reviewed work and energy theory", which was regarded as a summary within the framework of the CDF "Report"

Excerpt 131
Example 1 of an explanation and description with regard to Competence 1 in L3

24	T3	*Somehow it is moving from here to here, ok? (Showing on the board). Good! But it is* ***gradually*** *moving up, very slowly?* ***Initially*** *its kinetic energy is zero, so normally it is again at rest, no change in kinetic energy, so you can say that total work on the object is zero, okay? But of course, this gravitational force or applied force does work.* So, what did happen to these works? ***Because work and energy have some physical dimensions...***What happened? (…) *You can feel that…You can say* ***that there is an increase in the energy of the system of the object, but there is no change in the kinetic energy****, it is zero and there is no reason why the temperature of the object and external or internal energy should change. So, let's say change of internal energy is zero, but there is work done on this object, so this work appears as another form of the energy system.* ***This work appears in the total energy of the system. This work is converted into another form of energy****.*

In Excerpt 131, T3 was talking about the objects' works and their energy types that he drew on the board. This occasion was observed within the same lecture that the previous excerpt (i.e., 134) was detected. Thus, the main theme of the lesson was work and energy theorem. While describing the movement of the object on the board by employing the CDF "Describe" (i.e., process description) T3 used sequencers like gradually and initially. Then, he used the CDF "Explain" with the phrase "Because work and energy has some physical dimensions…". He did not complete his utterance because he was waiting for the students to predict as far as I deduced from his gestures and non-verbal cues occurring at that time. However, he could not get any answer from them. Therefore, he gave the answer by talking about the fact that work and energy have some physical dimensions. Those physical dimensions were the reason why kinetic energy of the object remains constant while the total energy increased. This occasion was coded as the use of the CDF "Explain" because of its causality. At the end, he concluded his statement with the issue of conversion of the work into another form of energy. Indeed, the whole lesson was about work and energy theorem, which was in line with competence 1, but a vast majority of the lesson included numerical formulations and equations which were hard to verbalize. This was among the occasions in which verbalizations took place. That was the reason why this episode was chosen as an example.

4.5.2.2. Competence 2

Regarding Competence 2 (i.e., *Define the dynamics and kinematics of rotational motion*), T3 employed the CDFs "Categorize" and "Define" to shape his lecture according to Competence 2. The following excerpts show the occasions which were in line with Competence 2.

Excerpt 132
Example 1 of a definition with regard to Competence 2 in L3

25	T3	Now, this is not constant. Put this here and integrate this here you will find this one *(Showing on the board)*, okay? This is for linear motion, and this is for angular motion. Rotational motion... So, you just put this on the table, a kinematic equation for rotational and linear motion under constant acceleration, okay? See? ***These are the kinematic equations for the rotational motion about fixed axis, and these are the kinematic equations for the linear motion with constant acceleration***. We're sure that in both cases, alpha and A are constant, okay? Alright.

In Excerpt 132, T3 firstly talked about some formulaic expressions that he wrote on the board to prepare the students for the introduction of kinematic equations for rotational and linear motions, required by competence 2. After he talked about those, he presented those equations by showing them on the board in detail. Therefore, he made a visual definition regarding Competence 2.

Excerpt 133
Exmaple 1 of a categorization with regard to Competence 2 in L3

21	T3	*Rotational Kinematics... Let's consider the rotational motion with angular acceleration. So, you can just establish* ***a similarity between the linear kinematic equations and angular kinematic equations***, okay? Remember one dimensional motion with constant acceleration. Can you give me the kinematic equations for this? What are the kinematic equations for the one-dimensional motion with constant acceleration?
22	S8	A is constant.
23	T3	A is constant, yes.

To address the objectives of Competence 2, T3 motivated students to find some similarities between linear and angular kinematic equations because they were the equations used in the concept of kinematics of rotational motion. The use of the word "Similarity" over there was in line with the nature of the CDF "Categorize" because T3 tried to make students think that those two equations shared a lot in common and they were the types of kinematic equations, which belonged to the broader category of rotational kinematics. Then, he asked students to give some examples of kinematic equations for these kinds of motions. The aim was to put

kinematic equations under the title of rotational kinematics. Therefore, this whole episode was regarded as an example of the CDF "Categorize".

4.5.3. Competences of the Dynamics lecture

Among the competences of Dynamics lecture, two of them were found to be connected to cognitive discourse functions which are as follows:

At the end of the course students will be able to:

Competence 1-*Compare force-mass-acceleration connections*

Competence 2-*Define the kinetics and linear motion of the material point*

Taking into consideration the length of the observed lectures, one occasion regarding each competence was chosen and analyzed.

4.5.3.1. Competence 1

Regarding Competence 1, T3 employed the CDF "Explain" mostly. A comparison seems to be the expected learning outcome of the Competence 1. However, it was observed that T3 generally explained the nature of the relationship between those three terms. Indeed, his explanations signaled a sort of comparison because he compared the situations in which related calculations were done differently as can be seen in the following excerpt.

Excerpt 134
Example 1 of an explanation with regard to Competence 1 in L4

38	T3	What is the angular acceleration? Zero. ***If there is no rotational motion, angular acceleration is zero***, so you can write down three questions again but the third one equals zero. *If you write down this total force moment about the center of mass…* ***If you write down the total force moment about any access through any other point other than G, center of mass this case, this is not going to be zero.***

In Excerpt 134, T3 was talking about a particular problem including a physical formula about the connection between the terms "Force", "Mass" and "Acceleration". He emphasized the importance of the place in which the total force

moment was put, because it might have changed the value of the angular acceleration. Therefore, he tried to highlight the fact that those terms were dependent on each other as a change in one of them was affecting the other. While doing this, he employed the CDF "Explain" by using conditional clauses. This occasion was labelled as the CDF "Explain" because T3 explained the consequential relationships between the terms "Force", "Mass" and "Acceleration" by using conditionals.

4.5.3.2. Competence 2

Within the scope of Competence 2 (i.e., *Define the kinetics and linear motion of the material point),* it was observed that T3 benefited from the various CDFs including "Define", "Report" and "Categorize" in occasions in which he talked about related things to Competence 2.

Excerpt 135
Example 1 of a definition, reporting and categorization with regard to Competence 2 in L4

4	T3	The last time, we worked on the mass moment of inertia, right? *Mass moment of inertia* ***is*** *a property of the object* ***that is the resistance to the angular acceleration of the object,*** right? We just put down some similarities between the linear motion and rotational motion (..), and***we have just reviewed*** *the motion kinematic equation for the constant acceleration,* right*? I just put down the kinematic equations for the linear motion and then, written down the kinematic equations for the rotational motion.For example****, torque force moment is a quantity corresponding to force****, right****?***

This occasion seems quite similar to the Excerpt 135 in terms of its content, mainly linear and angular motion, which were also covered in physics lesson. There were a number of similarities between physics and dynamics lesson and also, they both were delivered by T3. In Excerpt 135, T3 firstly defined the mass moment of inertia which was related to the kinetics of material point. While defining, he used both "Copula be" and "Relative clauses". Then, he reminded the students of kinematic equations regarding linear and rotational motion of objects. He summarized what he did concerning those equations, which was regarded as an example of the CDF "Report". After this, he gave some examples to boost students' schema with respect to the terms related to force and positions of the objects. The

term “torque force moment” was given as an example of a quantity of force, which was labelled as the use of the CDF “Categorize”. In both of the observed lectures, there were similar utterances concerning the same concepts, which were linear motion and kinetics of objects. The majority of those occasions were based on specific formulas or equations just like the given example. Therefore, the demanding nature of the competence 2 required T3 to employ various CDFs.

4.6. THE REALIZERS

The realizers of CDFs are also worth investigating in cognitive discourse functions studies. Within this respect, data regarding the realizers were tried to be obtained. However, it was found out that all of the observed lectures within the scope of this study were teacher-based. Therefore, this issue was not included in research questions of this study because there were almost no students’ utterances in English. It was impossible to make detailed analysis regarding the realizers of CDFs as a vast majority of CDF realizations were done by teachers. When students were supposed to answer in English, their contributions were limited to one or two words-long utterances. On the other hand, when they talked in their mother tongue, their utterances got longer. However, occasions in which Turkish was spoken were not included in the calculations of percentages in the framework of this study as it aims to investigate EMI settings. Nevertheless, some of the students’ contributions in Turkish, or half Turkish and half English, could be evaluated under the CDF construct. Therefore, those utterances were compiled and analyzed without externally which are shown in the following excerpts.

Excerpt 136
Example 1 of a student exploration in Turkish in L1

25	S3	Bir şey söyleyebilir miyim? *(Can I say something?)*
26	T3	He?
27	S3	Şurda bir tane electron diğer y orbitaline geçti ya ilk başta. *(One electron over*
28	T1	*there passed to the orbital Y at the beginning.)*
29	S3	Evet? *(Yes?)* Eğer orada onu uyarmasak, Z ile yine bağlanamaz mıydı? Bağlanmış olmayacak mıydı? *(If we did not stimulate it over there, would not it still be connected to Z?)*
30	T1	Ama burada onun oraya geçmesi gerekiyor önce. Uyarmamız gerekiyor. Uyarmak için benim yeni bir enerji vermem lazım. O enerjinin çok daha fazlasını zaten bond formation sürecinde geri kazanıyor molekül. *(But here, it has to pass there firstly. We need to stimulate it. To stimulate it, I need to give a new energy. The molecule can regain much more energy in the bond formation process.)*

Excerpt 137
Example 2 of a student exploration in Turkish in L1

168	S8	Hocam bu atlama meselesi az öncekinde de vardı da. Üstüne yük alanlarda mı oluyor sadece? Öyle bir genelleme yapsak, bununla alakası yok ama, doğru olur mu? (*Teacher, this jumping issue was present in the previous example, too. Does it happen only to the ones that possess a charge? If we make such a generalization, even if it is not related to this one, will it be true?*
169	T1	Yük almasıyla alakası yok. *(It is not related to its possession of charge.)*
170	S3	Ama öyle denk gelmişti de. Hepsinde acaba öyle denk gelir mi*? (But it just corresponded. Might this happen for all?*)
171	T1	Bunda var mı yük? *(Is there any charge on it?)*
172	S3	Gerçi onda da yok. *(Anyway, there is none.)*
173	T1	Bunda var mı? *(What about this?)*
174	S3	Yok. *(No.)*
175	T1	Tamamen atomic numberlarının sekizin altında olmasıyla alakalı çünkü onlarda 2S ve 2P enerji levelları birbirine yakın olduğu için bu 2S ve 2Pler mix oluyorlar. *(It is all about the fact that their atomic numbers are less than eight because these 2S and 2P orbitals mix with each other as a result of their proximity.)*

In both excerpts, it can be observed that students tended to come up with some hypotheses based on their personal thinking. They referred to the situations that T1 discussed earlier and suggested their own assumptions by uttering some conditional clauses in Turkish. Taking into consideration the fact that conditional

clauses are generally used in the realization of the CDF "Explore", phrases like "Uyarmasak (*If we did not stimulate it*)", "Bağlanmış olmayacak mıydı? (*Would not it still be connected?*)" and "Öyle bir genelleme yapsak (*If we make such a generalization*)" can be counted as conditional clauses. Therefore, these occasions can be evaluated as explorations made by students. Nonetheless, they were not included in descriptive calculations of the study because they were uttered in Turkish, not English.

Excerpt 138
Example 1 of a student explanation in L2

6	T2	Do you have any idea why we are using mercury although it is toxic?
7	S2	S: Because of density.

This excerpt is the one and only occasion in which a student realized a CDF in English. When the student encountered the question "*Why*?", he automatically thought that he was supposed to give an explanation, which he realized through the use of the subordinate conjunction "because of". Even though this example is suitable for analysis within the scope of this study, it was not included in the descriptive calculations again because it was the only example, which made it impossible to draw logical conclusions out of it.

4.7. CONCLUSION

In this section, the summary of main findings is presented.

1. The CDFs "Explain" and "Evaluate" were found to be the most prevalent types across all lectures.
2. The CDFs "Categorize", and "Report" were rarely observed compared to other CDF types.
3. There were more physical and process descriptions than structural and functional ones.
4. Complex CDFs were also observed, but not very frequently.

5. For the linguistic realization of the CDF “Categorize”, comparatives were prevalent followed by giving examples and using certain performative verbs.
6. For the linguistic realization of the CDF “Define”, the use of “Copula be” was common followed by “Subordinate clauses”, “Passive voice”, the verbs “Mean”, “Tell” and “Call”, and “Metatalk”.
7. Metatalk was observed mostly in definitions.
8. For the linguistic realization of the CDF “Describe”:
    a. Physical descriptions were realized through prepositions of location and adjectives.
    b. Structural descriptions were manifested through the verb “Have”.
    c. Functional descriptions include statements which were about the purpose or function of the thing which was described.
    d. Process descriptions were realized through the use of sequencers like “First/second/the first step/the second step/initially/lastly”.
9. For the linguistic realization of the CDF “Evaluate”, adjectives and adverbs (i.e., careful(ly), better, easy/easily/ important(ly)) were used.
10. For the linguistic realization of the CDF “Explain”, subordinate clauses were the most common tools followed by coordinate clauses and conjunctive adverbs.
11. For the linguistic realization of the CDF “Explore”, particular performative verbs like *say, think, guess, imagine,* and *assume* were found to be common followed by modal verbs and subordinate clauses.
12. For the role of the CDF “Report”, presenting facts and research/experiment results were prevalent followed by referring to a previous point and summarizing.
13. For the achievement of the key competences of the observed lectures, the CDFs “Categorize”, “Define”, “Describe”, “Explain” and “Report” were mostly preferred.
14. All of the lectures were found to be teacher-centered, which means that student contribution was quite limited. Students occasionally participated in lessons by speaking in English. However, they still participated in lectures by speaking in their mother tongue (i.e., Turkish).

CHAPTER 5

5. DISCUSSION AND CONCLUSION

5.1. INTRODUCTION

The aim of this chapter is to discuss the findings of the current study by referring to (i) the most preferred CDFs in EMI classes, (ii) the particular lexicogrammatical structures to realize those CDFs, and (iii) the ways of achieving the key competences of the observed lessons through the use of CDFs by referring to the existing body of literature. In this regard, the results of the studies both conducted in English medium instruction (EMI) and Content and language integrated instruction (CLIL) settings were compared with the results of the current study as the studies regarding CDFs in EMI settings are not sufficient to make comparisons. In addition to the discussion part, limitations of the study and pedagogical implications are provided. In the last part, implications for further research are presented.

5.2. DISCUSSION OF THE FINDINGS

5.2.1. The most observed cognitive discourse functions

Regarding the first research question, there were 1666 CDF passages in the compiled corpus, which was based on 20 lessons. The duration of the lectures was not stable but generally a lecture lasted more than 90 minutes with intervals. Therefore, 32 hours (1897 minutes) of lesson observation was done. When related calculations were done, it was found out that approximately 83 CDFs were realized per lesson, which equals approximately three CDF realizations within every two minutes. To compare these descriptive results to the existing body of research regarding cognitive discourse functions, studies conducted in the context of CLIL are taken into consideration because the studies regarding EMI contexts mostly focused on individual CDF occurrences with no descriptive data about the general distributions.

Concerning the theses conducted on the field of cognitive discourse functions. Brückl (2016) examined six Economics lessons and came up with 480 CDF passages, which equals to 80 CDFs per lesson. Therefore, one CDF was realized within every two minutes (p.98). In Kröss's (2014) study, observation of six hours of physics lessons was done and 95 CDF passages were found in total and 16 per lesson, which equals one CDF realization within every three minutes (p.45). Hofmann and Hopf (2015) examined eight Biology CLIL lessons and found 610 CDF passages in total and 77 per lesson. Correspondingly, two CDFs were realized within every three minutes (p.83). As different from the other theses, Lechner (2016) examined eight English as a foreign language (EFL) lessons and came up with 481 CDF occurrences in total and 60 per lesson, which means that two CDF passages were realized within every three minutes. When taking into consideration the fact that the collected corpus was far bigger than those of these theses, three CDF passages within every two minutes may seem lower. However, both the duration of the observation done in those theses are shorter than the one in the current study and the occasions in which the students talked in their native language were also taken into consideration and evaluated as the realization of some CDFs. On the other hand, the occasions in which students participated in the lessons were not sufficient to be taken into consideration in this study. Besides, almost all the students' contribution in the scope of this study was done in Turkish, which was students' mother tongue. Those occasions were not taken into consideration because this study aimed to investigate the use of cognitive discourse functions in English as a medium of instruction (EMI) classes.

When it comes to the most common CDF types regarding the first research question, the CDF "Explain" with 476 occasions and "Define*"* with 474 occasions were found to be the most frequent types. For the Departmental General Chemistry lecture (L1), "Explain" was by far the most common CDF type. For the General Chemistry lecture, which was across disciplines, the CDF "Define" was the common one. This difference might have been arisen from the fact that the students in the former lecture (i.e., L1) were familiar with most of the concepts because their department was Chemistry. However, the students enrolled in the other Chemistry lecture (i.e., L2) were coming from different disciplines, which means that they were

not familiar with most of the chemical terminologies. Therefore, T2 frequently made definitions in order make the students get to know the related terms better. Regarding this, it can be stated that students' background concerning their departments has an impact on the preference of CDFs employed by the teachers. As for T3's classes, "Define" was the dominant CDF type in physics while "Explain" was the most observed one in the Dynamics lecture.

As a general comparison between the current study and the other theses conducted on this issue, the CDF "Define" was also found to be the most preferred CDF type in the study conducted by Brückl's study, together with the CDF ``Report" (2016: p.88). As a similar finding, Lechner's study in which she examined EFL classes, the CDFs "Define", "Describe" and "Explain" were found to be the most observed ones (2016: p.112). The reason why the CDF "Report" was highly observed in that study may be attributed to discipline-based differences. Lechner's study examined EFL classes in which lots of grammatical rules and language-related information had to be delivered, which could be done best through the use of the CDF "Report". However, the Chemistry, Physics and Dynamics classes observed within the scope of this study were generally based on the solution of subject-oriented problems, delivery of certain terminological expressions and causal relationships regarding chemical reactions or physical actions, which were mainly conveyed through other CDFs, not "Report". In Hofmann and Hoph's study,"Describe" and "Define" were the most prevalent ones in the observed CLIL biology lectures (2015: p.204). Dalton- Puffer et al. (2018) also found out that "Describe" was the prominent CDF followed by "Define" and "Explain" (p.26). In Kröss's study, "Describe" was the most observed one (2014: p.81). Similarly, Dalton-Puffer and Bauer-Marschallinger (2019) also found out that the CDF "Describe" was the most common one (p.44). However, the results in which the CDF "Describe" was found to be the most observed CDF type are opposed to the findings of the current study. In the framework of this study, the CDF "Describe" was found to be the fourth observed CDF type, which consisted 10% of the total number of coding. In spite of the fact that Physics lessons were observed in both Kröss's study and the current study, "Describe" was found to be the most common CDF in that study while "Define" was the most prevalent one in the within the scope of the

current study. This difference may arise from the fact that the settings in which those two Physics classes were held were different. Kröss's study was based on CLIL settings whereas the current one is based on EMI. The possible reason why "Define" outnumbered in the observed Physics lessons of this study may be that T3 needed to define the terms in detail before moving on further descriptions. Students enrolled in that Physics class either passed the proficiency exam held by the institution or took a one-year preparatory program. However, the training given in that program is questionable. I could be observed that those students have difficulty in following the lessons smoothly, especially in terms of vocabulary. In that preparatory program, there is no opportunity for students to get a vocational English program in line with their own departments. That is why, their terminological background was relatively weak, which necessitated lots of definitions done by the teacher. Apart from this point, the findings of this thesis are in line with the results of the previously conducted research in terms of the prevalence of the CDF "Define".

With respect to the least observed CDFs, "Evaluate" (EV) and "Categorize" (CA) were the least occurring ones in this study. In Kröss's study, those functions were also found to be the least common ones (2014: p.81), which supports the findings of the current study. In a similar manner, Hofmann and Hopf found out that "Evaluate" was among the least observed CDF types together with "Classify (Categorize)" and "Report" (RE) (2015: p.204). "Evaluate" was also the least observed CDF in Brückl's study (2016: p.56). As a close finding with the results of the current study, Dalton-Puffer and Bauer-Marschallinger (2019) stated that the CDFs "Categorize" and "Report" were the least occurring ones (p.44). The CDF "Report" was the third most observed type after "Define" and "Explain" in the framework of this study. As another different finding, Lechner (2016) concluded that the CDF "Explore" was the infrequent one in her study (p.112). On the other hand, "Explore" was found to be the fifth most observed one with 154 occurrences in the current study, which is not in line with the results of the study done by Lechner (2016).

5.2.2. Linguistic realizations of cognitive discourse functions

One of the core parts of this study was the analysis of the particular linguistic structures used to realize cognitive discourse functions (CDF) in the observed lectures. A bunch of different lexicogrammatical manifestations regarding the realization of CDFs were found. Related studies focusing on both teachers' and students' utterances were analyzed and compared with the results of the current study because I personally aspired to come up with general results in terms of realization of the CDFs irrespective of the realizers.

5.2.2.1. The CDF "Categorize"

For the CDF "Categorize", three main linguistic patterns were detected: i) Comparisons and adjectives, ii) the phrases "Type of", "Kind of", and "Example of" and iii) the use of certain verbs like "Group", "Compare" and "Classify". Lechner (2016) found out that the CDF "Classify" (as mentioned there) or "Categorize" were realized through utterances like "X is a member of Y" which is very similar to the phrases "Type of", "Kind of", and "Example of" which were found in the scope of this study. Besides, she also detected the use of the verb *"belong to"* (p.90) in the realization of the CDF "Categorize". I also observed various verbs like *group, compare,* and *classify* while as the linguistic manifestations of the CDF "Categorize". Thus, it can be stated that, the CDF "Categorize" can be realized through the use of some verbs. Dalton-Puffer and Bauer-Marschallinger (2019) found out that comparisons, were mostly preferred as the lexicogrammatical realization of the CDF "Categorize". However, they focused on students' contributions in their study as different from the current study. They found out students' utterances like "The IR was much more than a volution in history.", which is an example of a comparison in realization of the CDF "Categorize". Evnitskaya and Dalton-Puffer (2020) also observed that students tended to compare things or concepts based on their similarities and differences whereby they employed comparative forms of adjectives with regard to the realization of the CDF "Categorize" (p.15). The observation of comparisons and adjectives in the realization of the CDF "Categorize" is in line with the results of the current study as their usage was frequently observed. As a different

finding, Dalton-Puffer and Bauer-Marschallinger (2019) detected the use of some adverbs like *nowadays, today* and *now* in the realization of the CDF "Categorize" (p.48). However, no adverbs were found regarding the linguistic manifestation CDF "Categorize" in the current study because the lectures observed in Dalton-Puffer and Bauer-Marschallinger's study were history classes while the ones in this study were chemistry, physics and dynamics. Breeze and Dafouz (2017) investigated students' answers and found out that categorizations were generally realized through linking some specific features of a thing to a broader concept (p.86), which was also the idea behind the observed categorizations in the current study. Furthermore, they came up with the result that the CDF "Categorize" or "Classify" (as mentioned there) were generally found to be combined with other CDFs like "Explain" and "Describe", which were named as complex CDFs. Dalton-Puffer (2013) suggests that Classifying is generally a component of the CDF "Define", but not all definitions include the CDF "Classify" or "Categorize" (p.236). Therefore, it is possible to find out the usages of the CDF "Classify" together with "Define" because classifying or categorizing requires the activation of two cognitive functions at the same time, which makes the occurrence of complex CDF neutral (Breeze and Dafouz, 2017: p.88). Likewise, although they were not very frequent, there were occasions in which the CDFs "Define" and "Explain" were observed together with "Categorize", which supports the findings of the study conducted by Breeze and Dafouz in 2017.

5.2.2.2. The CDF "Define"

Dalton-Puffer (2016) asserts a formula consisting of "Definiendum (i.e., the term to be defined) =Definiens (i.e., the broader category that it belongs to) + differences (i.e., its specific features)" regarding definitions. This formula is realized through the use of "Copula be" structure, named as formal or canonical definitions. However, she also states that there may be a number of different realizations of definitions, called semi-formal definitions. For instance, synonyms or antonyms can be used or one of the components of the formula may not be included (p.36). Correspondingly, for the realization of the CDF "Define", four main categories were detected in this study: i) Copula be, which is the formal definition structure, ii) Passive voice, iii) Subordinate clauses and iiii) the verbs "Mean", "Tell" and "Call".

There were also instances of metatalk employed by T3 in the Physics lectures while giving definitions. Lechner (2016) found out that relative clauses were highly used in addition to formal definitions realized through the structure "Copula be" (p.93). This result is in line with the findings of the current study because a number of occasions in which relative clauses were used to define a thing were found. These occasions were investigated under the main category of the use of "Subordinate clauses" in definitions. However, the use of "Conditional clauses", "Passive voice" and the verbs "Mean", "Tell" and "Call" were not mentioned in Lechner's study, which is a different finding. In Dalton-Puffer and Bauer-Marschallinger's study (2019), it was found out that learners tended to use "Passive voice" or "Copula be" structures while giving definitions (p.47). Even though it was not based on the construct offered in 2013 and 2016, Dalton-Puffer also observed the prevalence of formal canonical definitions formulated with the use of "Copula be" and "Relative clauses" in her study (2007: p.133-136). These results support the findings of the current results in terms of the ways of realization of the CDF "Define". However, there were some occasions in Dalton-Puffer's (2007) study in which students made translations as a response to the teachers' question "What is X?", which were regarded as definition-translations (p.136). Those kinds of utterances were not regarded as definitions, but they were coded as "Define + Translate" and examined separately in the scope of the current study. Moreover, Dalton-Puffer and Bauer-Marschallinger (2019) also came up with different structures like "X refers to" and "We define X as...". One important and parallel finding with the results of this study was that about 50% of students' definitions consisted of just labelling or naming the things to be defined (p.47). In this study, students were also inclined to give one-word answers or just the name of the things to be defined as an answer for the teachers' question "What is X?", which were not regarded as complete definitions in the scope of this study. Referring to Sobhy's study in which she investigated learners' language use studying at EMI settings but adopting CLIL principles, she found out that learner definitions took place in various ways among which the use of "Relative clauses" and "Copula be" were observed (2018: p 109). Results of the current study also showed that the use of "Copula be" and "Subordinate clauses" in which relative clauses were included, composing a remarkable place in the realization of the CDF "Define". In the preliminary study conducted by Kääntä, Kasper and Piirainen-Marsh in 2016, the

realization of definitions were analyzed from a wide perspective including non-verbal cues as well. Regarding lexicogrammatical structures to give definitions, it was found out that the structures like "X means Y" were found to be abundant (p.705) which was also observed in the framework of this study and those occasions were coded under the title of the verbs "Mean", "Tell" and "Call". In her subsequent study, Kääntä (2021) evaluated teachers' definitional practices in CLIL history and physics classes by taking the CDF construct offered by Dalton-Puffer (2013,2916) as the reference. It was concluded that a range of different linguistic realization of the CDF "Define" were observed rather than mere usage of formal definitions which were realized by "Copula be" structure. For instance, "Definiendum" or the thing to be defined, was generally delivered separately instead of being included in a single statement. Likewise, the number of occasions in which relative clauses were used to give definitions was high. She also observed that terminological additions to definitions in Physics lessons were more prevalent than history lectures. After the Physics teacher defined a physical term by using everyday words, then he added more technical terms to definitions as opposed to the history teacher. It was also found out that the Physics teacher benefited from drawings and shapes that he drew on the board while defining something (p.26), which was also in line with the results of the current study as visual aids were observed a lot in the Physics lectures observed in the scope of the current study. Kääntä (2021) also stated that history teachers used realia a lot while defining the terms (p.27). Similarly, Chemistry teachers in this study used realia to define things, too. For instance, T1 used the 3D modelling of the chemical molecules to define the shapes of them while T2 used papers while talking about the phenomenon of shielding. Hopfman and Hopf (2015) investigated the types of definitions under three different categories which were called formal, semi-formal and non-formal definitions, respectively (p.126). The first is again divided into two different branches which are named as explicit and non-explicit formal definitions (p.129). Explicit formal definitions refer to the exact definitions in which the words "Define and definition" were used. These kinds of utterances were evaluated under the title of metatalk in this study. Non-explicit formal definitions were the ones in which relative clause structure was used, which is in line with the findings of the current study as the use of relative clauses in definitions were also observed in the current study. Semi-formal definitions were the

ones in which the conjunction “In other words” was used and it has a summarizing function. This result is different from that of the current study because such usages were not observed. Furthermore, the utterances which have a summarizing function were regarded as the CDF “Report”, not “Define”, in the framework of the current study. Non-formal definitions in their study were generally realized through the use of phrases like “Is/are known as' ', “Means”, and “Are referred to as" (p.131). This result supports the findings of the current study because I also came up with categories like passive voice and the verb “Mean” in terms of the realization of the CDF “Define”. However, they evaluated the use of the phrase “The same as” under the category of definition. However, such structures were regarded as categorizations in the current study, which is also a different finding. Lastly, the use of “Copula be” was predominantly observable in students’ definitions while other structures like passive voice, relative clauses, the verbs “mean” and “refer” were remarkably detectable in teachers’ utterances found in the study conducted by Doiz and Lasagabaster (2021: p.65). This result also supported the findings of the current study because a majority of those structures were also highly observable in this study.

5.2.2.3. The CDF “Describe”

The CDF “Describe” was investigated under four main categories: i) Physical, ii) structural, iii) functional, and iiii) process descriptions. Process descriptions were found to be most observed ones followed by physical, structural and functional descriptions respectively. In Hofmann and Hopf’s (2015) study, physical descriptions were the dominant ones followed by process, functional and structural descriptions in CLIL biology lectures. In Dalton-Puffer and Bauer-Marschallinger’s study, physical descriptions realized by students were observed more than others (2019: p.44). Physical and process descriptions were also prevalent in the current study. The reason for the prevalence of process descriptions in the current study and Hofmann and Hopf’s study could be that the observed lessons in both studies were physical science lessons (i.e., Physics and Biology), in which chemical, physical and biological reactions were supposed to be described. For physical descriptions, Hofmann and Hopf (2015) stated that utterances regarding the

visible features of the objects like their shape, size and color were evaluated as physical descriptions (2015: p.144). Concerning physical descriptions, Breeze and Dafouz (2017) marked concrete features of objects as descriptions, but they did not investigate descriptions in separate types. Kääntä (2021) also came up with utterances including size and shape of the objects (p.26). These results are in line with the findings of this study. Structural descriptions were about the utterances related to the relationship of an object and with its inner parts (p.149). The linguistic patterns observed in those occasions were generally "X is made up of..." and "X has…". The same criteria were applied in the current study as well. However, Lechner (2016) coded structural descriptions under the CDF "Categorize" (p.95) because of the notion of part and whole. This approach was not assumed in the current study as structural descriptions were evaluated separately as an individual category. Functional descriptions were generally based on the utterances like "The purpose of x is to…" in Hofmann and Hopf's study (2015: p.151). Likewise, the utterances coded under the category of functional description in this study were generally about the usage areas or purposes of the objects. For the realization of the process descriptions, Hofmann and Hopf (2015) found out that certain conjunctions like *at first, and, and then* were found to be common (p.153) just like it was found out as sequencers in the scope of the current study. Lechner (2016) stated that no prevalent lexicogrammatical patterns were detected regarding descriptions. Instead, utterances sharing some common features were categorized accordingly. For example, statements regarding outward features of objects were included in physical descriptions while utterances involving phrases like "Part serves to/controls/regulates/is responsible for function" were coded under functional descriptions (p.96). The same logic applied in this study as well and no common linguistic pattern was reached concerning descriptions in this study, too.

5.2.2.4. The CDF "Evaluate"

This CDF was mainly realized through the use of adjectives and adverbs (i.e., *important(ly), careful(ly), better* and *easy/easily) i*n the current study. Brückl (2016) stated that when the teachers made evaluations or took a personal stance towards the

topic they discussed, they generally came up with some logic to support their point, which she called “a fuzzy border”, delivered through “Evaluate + Explain” episodes (p.82). This result supports the findings of the current study because when the teachers tried to emphasize the importance of a topic by using adjectives like important, they tended to complete their utterances with the subordinate conjunction “Because” to give explanations about the importance of the topic. These occasions were examined under the category of complex CDF within the framework of the current study. Lechner (2016) found out that the phrase “I think” was the prominent lexicogrammatical realization of the CDF “Evaluate” in their study, which is a different finding from the results of the current study. Besides, she detected some phrases like “Which is a good/problematic thing” (p.100). Those usages support the use of the adjectives in the realization of the CDF “Evaluate” since “Better” and “Easy” were used by the teachers to express their personal opinions about the topics in the current study. Dalton-Puffer and Bauer-Marschallinger (2019) also observed the combination of subordinate clauses (mainly with “Because”) with the realization of the CDF “Evaluate” (p.48). Other than this, words which signal values were also examined under the category of “Evaluate” in that study just like it was done in the current study. As another supportive finding to the current study, Hofmann and Hopf (2015) found out utterances like “This is important/useful because…”, which are examples of the combination of the CDF “Evaluate” and “Explain” (p.159). This result is also in line with the findings of the current study in terms of the presence of the CDF “Evaluate” with “Explain", which makes the complex CDF “Evaluate + Explain”. In Doiz and Lasagabaster’s study, in addition to the use of adjectives and adverbs like *useful* and *surprisingly*, teachers’ utterances including personal judgments like “I do not agree with that ″ were observed (2021: p.65). This result is different from the findings of the current study as there was no statement signaling such kind of personal judgments throughout all observed lectures in this study. This may be because of the fact that the observed lessons in this study were about physical sciences while the one in Doiz and Lasagabaster’s study was history, which could be open to interpretations and personal judgments.

5.2.2.5. The CDF "Explain"

The CDF "Explain" was the most common type in the collected corpus of this study. It was realized through three main lexicogrammatical structures which are subordinate clauses, coordinate clauses, and conjunctive adverbs. Within this respect, Martín del Pozo (2016) examined how explanations took place in EMI classes. He compiled observed explanations under three main categories (i.e., *interpretative, descriptive and reason giving explanations)* (p.112) which respond to the questions *what, how* and *why,* respectively. The subordinate conjunction "Because" was found to be the dominant linguistic pattern throughout explanations in that study (p.116). Likewise, "Because" was observed as a causal conjunction in both teachers' and students' responses in the studies conducted by Dalton-Puffer (2007: p.158) and Hofmann and Hoph (2015: p.164). These results support the findings of the current study because the subordinate conjunction "Because" was the predominant structure in the realization of the explanations through subordinate clauses within the framework of this study. Martín del Pozo (2016) also detected the exact usages of the words "Explain" and "Explanation" in the realization of the CDF "Explain" (p.117) which were regarded as metalanguage just like it was done in the current study. Hofmann and Hopf (2015) examined the realization of the explanations under the categories of the use of *causal* and *consequence conjunctions* (p.164). Even though the categorization is different from that of the current study, the examined conjunctions in those categories are similar to the ones observed in the current study. For example, the coordinate conjunction "So" was labelled as a consequence conjunction in that study, and it was observed in a number of occasions just like it was detected in the current study. Lechner (2016) found out the conjunction "Because" was the only lexicogrammatical structure to realize the CDF "Explain" in her study (p.101). In Breeze and Dafouz's study (2017), the structure signaling causal relationships were found to be "So (that)" (p.84) and occasionally "Because" as a connector (p.87). These findings are partially in line with the result of the current study because "So" and "Because" are among the structures that realize the CDF "Explain" in the current study, but there were also a range of different realizations which were not mentioned in those studies. As a parallel finding with that of the current study, Dalton-Puffer and Bauer-Marschallinger (2019) observed the

prevalence of subordinate clauses constructed with the conjunction "Because" in the realization of student explanations (p.45). Likewise, Doiz and Lasagabaster (2021) stated that the conjunctions "Because" and "That is why" were frequently observed in the realization of the CDF "Explain" (p.63), which also supports the findings of the current study. In brief, it can be stated that although the grouping preferred for the linguistic patterns to realize the CDF "Explain" in the existing body of literature differs, the prevalence of the conjunction "Because" and "So" is in line with the results of the current study. However, the lexicogrammatical structures to realize the CDF "Explain" differ when compared to the results of the other studies, which implies a difference.

5.2.2.6. The CDF "Explore"

The realization of the CDF "Explore" in the current study was based on three different linguistic patterns which are the use of modal verbs, subordinate clauses, and particular verbs respectively. Lechner (2016) detected the use of modal verbs, modal adverbs, and conditionals in the realization of the CDF "Explore". Particularly, the verbs "Assume", "Guess" and "Imagine" and the phrases "Let's say", "What happens if" and "Can you predict" were observed a number of times regarding the CDF "Explore" in her study (p.103). These findings are quite similar to the results of the current study because exact findings were reached in the current study as well. Specifically, the phrase "Let's say" was observed in a number of times in T3's lectures and most of them were functioning as explorations, which was also found within the framework of Lechner's (2016) study. Structures with the modal verb "Would" (e.g., *What would you do?*) were also found to be common in the study done by Hofmann and Hoph (2015: p.177). They stated that those kinds of utterances motivated students to think further about the possible outcomes (p.179). Similarly, Brückl (2016) concluded that teachers tended to use modal verbs to come up with different questions to make students theorize about the potential outcomes or situations about the given topic (p.85). These findings were also observed within the framework of the current study. To increase students' participation and encourage them to think about potential scenarios, all participant teachers used utterances with

the modal verb “Would” to some extent, which were regarded as one of the ways to realize the CDF “Explore" in the current study. Moreover, Hofmann and Hoph (2015) pointed out that students made a number of assumptions which were evaluated as the realization of the CDF “Explore” (p.179). There were also such occasions in the current study as mentioned before, but they were not included in descriptive calculations because they were realized in Turkish, not English. The use of verbs like “Suppose”, “Think” and “Guess” were also observed in that study (p.180), which was also a parallel result with the findings of the current study. Lastly, Dalton-Puffer and Bauer-Marschallinger (2019) found out that students used phrases like “I think” and “Maybe” to express their hesitation which was regarded as the realization of the CDF “Explore” (p.49). The phrase “Maybe” was also observed in the current study on some occasions in which teachers were not sure about the applicability of some formulas or equations.

5.2.2.7. The CDF “Report”

There were a number of different lexicogrammatical realizations of the CDF “Report” in the scope of this study. Since it was hard to group those realizations under certain categories, the different roles of the CDF “Report” were analyzed in the current study. The main roles of the CDF “Report” were found to be summarizing, referring to previous points and presenting facts or research results, respectively. In this regard, Doiz and Lasagabaster found out several realizations of the CDF “Report” based on narration of serial events (2021: p.67). In the framework of the current study, such narrations were also observed especially when the teachers were talking about ancient times when the chemical compounds were not fully discovered, which were evaluated under the title of presenting facts or research results. Brückl (2016) stated that the main function of the CDF “Report” in her study was to summarize the main subjects and terminologies which had already been mentioned to increase students' level of comprehension (p.85-86). This result supports the findings of this study regarding the summarizing function of the CDF “Report” because there were a number of occasions in which the teachers summarized or revised the topics. They used the summary function to foster students’ learning and make logical connections with the upcoming topics. Hofmann

and Hopf (2015) examined the occasions in which they observed the CDF "Report" under three categories which were *research, discourse,* and *cognition acts* (p.185). Research acts were about the reporting of research or observation findings through reporting verbs, and it was the most observable category throughout all occasions coded to the CDF "Report". This result is in line with the findings of the current study since "Presenting facts or research results" was the most prevalent function of the CDF "Report" within the framework of this study. Revisions and reformulations of the previous utterances were evaluated under the category of discourse acts in Hofmann and Hopf's study (2015: p.189). These were found to be the second most occurring one. Both the categories of referring to a previous point and summarizing in the current study correspond to the category of discourse acts offered by Hofmann and Hopf (2015: p.58), which indicates that such usages were also observable in the realization of the CDF "Report" in their study. Cognition acts were about the mental processes of the realizers, but they found no occasion regarding those. Instead, they came up with unspecified acts composed of *personal, case, summary, introduction,* and *input reports* (p.197-198). Personal reports were about the teachers' personal anecdotes whereas case reports were based on experiences of a third person. Introduction reports were about important topics which would be discussed followingly while input reports were composed of merely subject-specific delivery of content. Occurrences regarding personal, case and introduction reports were not observed in the scope of the current study, which can be counted as a different result. Summary and input reports (i.e., *presenting facts* in the current study) were observed but they were investigated under separate categories within the framework of this study. Lechner (2016) used a similar approach to examine the realization of the CDF "Report". She looked at research, discourse and cognition acts but again there were no occasion concerning cognition acts (p.105). As for research acts, she observed the use of the verbs like "Show, "Confirm" and "Find" and other structures like "Overall conclusion", "Must be that" and "Therefore". The use of the verb "Show" was prevalent in terms of presenting facts or research results because there were occasions including utterances like "Experiments show that…" in the current study. For discourse acts, Lechner (2016) stated that verbs like "Talk about", "Say" and "Mention" were used to realize the summarizing function of the CDF "Report" (p.106), which was also a common phenomenon in the current study.

5.2.2.8. Metatalk

There were 65 instances of metatalk in the current study and a vast majority of them were observed while teachers were defining something. Most of them were detected in the Physics lecture (i.e., *L3*) with 53 occasions. There were not many descriptive examinations regarding the use of metatalk in the previously conducted studies. Krösss found out 32 occurrences coded as *metalanguage* (2014: p.76). As different from the findings of the current study, those occasions were generally observed while teachers were describing a concept. Hofmann and Hopf (2015) stated that they came up with quite a few occasions in which metatalk was observed. They were generally observed in the realization of the CDFs "Define", "Explain" and "Explore" (p.199). Dalton-Puffer (2007) observed no occasion of metatalk regarding definitions (p.132), but she detected some metatalk occasions for the CDF "Explain" in her study (p.156). This result is not in line with the findings of the current study because metatalk was mostly observed in the realization of the CDF "Define.

5.2.3. The use of cognitive discourse functions to achieve key competences

One of the main aims of the CDF construct offered by Dalton-Puffer is to provide learners with particular linguistic competences which are necessary for academic success (2013: p.218). In this regard, key competences of the observed lessons were analyzed carefully, and it was found out that some of them were closely related to cognitive discourse functions. Such an analysis was done by other scholars, too (Dalton-Puffer and Bauer-Marschallinger, 2019; Doiz and Lasagabaster, 2021). Dalton-Puffer and Bauer-Marschallinger analyzed how historical competences in their observed lectures were met through students' use of cognitive discourse functions as a part of their study (2019: p.43). They took the FUER competency model, which forms the theoretical basis of Austrian history curriculum, as the reference. In FUER model, historical awareness was based on two main competences (i.e., *terminology* and *structuring competence*). Regarding these two competences, there were also sub-competences (i.e., *questioning*, *methodological*, and *orientation competence*). As the general results of the study, it was found out that CDFs functioned as a useful tool for the analysis of history education in terms of key

competences. Indeed, they were found to be among the indispensable parts of a competency-based history education (p.55). It was observed that students made use of various CDF in all competences except for questioning competence, which was rarely observed in that study (p.51). One important and parallel finding was that students tended to use the CDF "Define" in the framework of terminology competence (p.52). This competence was generally based on the notion that students' capability to comprehend and use terms related to history (p.39). In this sense, it can be stated that this result supports the findings of the current study in terms of achieving key competences through the use of CDFs. In the current study, competence 2 in Chemistry lectures (i.e., "*Define basic chemical terms and rules both theoretically and practically")*, both competences in Physics lecture (i.e., *Define work and energy theorem"* and *"Define the dynamics and kinematics of rotational motion"")* and competence 2 in Dynamics lecture (i.e., *Define the kinetics and linear motion of the material point)* included the use of the CDF "Define". All those competences were based on particular terminologies regarding Chemistry, Physics and Dynamics which required the preference of the CDF "Define". Hence, this result supports the findings of Dalton-Puffer and Bauer-Marschallinger's study in terms of the use of the CDF "Define" while delivering subject-specific terminologies.

Doiz and Lasagabaster also investigated how historical competences were met through the use of CDFs (2021: p.58). They chose three competences of history lectures in accordance with the CDF construct offered by Dalton Puffer (2013,2016). In the scope of the first competence in that study (i.e., *"To give an account of the historical events and processes discussed in the course and establish links between them and the present time*)", teachers employed the CDFs "Describe", "Report", "Explain" and "Evaluate" (p.63). This competence and the first competence in Chemistry lessons of this study (i.e., "*Have knowledge of the scope of modern chemistry, its methodology and application and improve their capability to describe the physical world")* have a lot in common. Both competences require the delivery of general knowledge concerning the subject. Correspondingly, the CDFs "Describe" and "Report" were also observed in the realization of the Competence 1 in chemistry lectures within the framework of the current study, which is a parallel finding with

Doiz and Lasagabaster's study (2021). Teachers mainly employed the CDF "Report" to construct the target content and they used the CDF "Describe" to give more details about it in both studies. Concerning Competence 3 (i.e., *"Use specialized terminology to talk and write about the topics covered in the courses appropriately"*) in Doiz and Lasagabaster's study, teachers mostly employed the CDF "Define" (2021: p.65). This result is also in line with the findings of the current study because all competences based on the definition of subject-specific terminologies were achieved through the teachers' use of the CDF "Define" in this study, too. When they were introducing new terms or concepts in all lectures, they firstly defined them through the use of various linguistic patterns, and they described or explained them afterwards. However, the CDF "Evaluate" was observed in the realization of two of the key competences investigated in Doiz and Lasagabaster's study (2021: p.63-64). Teachers included their own personal judgments while addressing the requirements of the competences in that study. Such a tendency was not observed in the current study. This might have happened because of the fact that the observed lectures in this study were about science (i.e., chemistry, physics and dynamics) whereas the ones in Doiz and Lasagasbaster's study were about history, which is a field open to personal interpretations.

5.2.4. The realizers

The general result regarding the realizers showed that all lectures observed in the scope of this study were teacher centered. The same situation was observed in An and Macaro's study (2021: p.32). Even though the focus was not CDFs in that study, it was found out that teachers dominated classroom interactions in Chinese EMI science lessons in high school level and students' contribution were not linguistically complex (p.2), which was also among the findings of this study regarding realizers. Similarly, teachers had to be dominant in classroom interaction because students did not participate in lessons by speaking in English. There were still occasions in which students responded to teachers' questions by speaking in English. However, those contributions did not go beyond one or two-word utterances, which could not be evaluated as the use of the CDFs by students. When students actively participated in lessons, they mostly talked in Turkish, which was their mother tongue. Regarding the

dominance of teachers in the realization of CDF, Hopfman and Hoph (2015) found out that teachers were by far the most responsible agent in terms of the realization of the CDF (p.205). They found out that students had a small contribution in the realization of the CDF "Explore" when constantly pushed by the teacher. This is also a parallel result with the findings of the current study as there were also students' explorations in this study triggered by the teachers' thought-provoking questions. However, they were not included in descriptive calculations since they were realized through Turkish, not English. Hopfman and Hoph (2015) indicated that students' reluctance to participate in lessons by speaking in English was because of their low self-esteem (p.206). A similar stance can be assumed in the current study because students explicitly expressed their willingness to speak in English on some occasions. Even if some students knew the answer to teachers' questions, they avoided responding as they did not want to talk in English. They uttered sentences like "Hocam, Türkçe söyleyebilir miyim? *(Teacher, can I say it in Turkish?)* or "Hocam, Türkçe anlatsam ne olur? *(Teacher, what if I tell it in Turkish?)* to ask for permission from the teacher to answer in Turkish. The reason why students were unwilling to speak in English was probably due to their low self-esteem as Hophman and Hopf (2015) claimed. It was observed that when some of the students attempted to give answers in English, their peers tended to make fun of them because of their mistakes. This results in students' reluctance to participate in lectures by speaking in English.

Regarding other students existing in the current body of literature, Brückl, on the other hand, found out that 37% of CDF was realized by students and 18% of them were achieved through teacher-student interactions. Therefore, teachers realized less than half of the total number of coding (i.e., *45%*) in her study (2016: p.73). Likewise, 59% of realization of the CDF was based on students in Lechner's study (2016: p.67). In Krösss's study, even though students' role was found to be lower (i.e., *6,3%*), teacher-student interactions constituted 58,9% of total CDF realizations (2014: p.53). These results are different from that of the current study as student participation or teacher-student interactions were not rich in terms of realization of the CDFs.

5.3. CONCLUSION

This study aimed to investigate the use of cognitive discourse functions in EMI lessons, the linguistic patterns that were employed to realize those functions and the way the key competences of EMI lessons were met through the use them. To investigate these issues, the CDF construct offered by Dalton-Puffer (2013: p.234; ,2016: p.32-33) was taken as the reference. Accordingly, seven different CDFs were investigated in the collected corpus. Some of the CDF observed more than others as required by the nature of the lectures. All of the observed lectures were about physical sciences (i.e., *Chemistry, Physics* and *Dynamics*) in which lots of subject-specific terminologies and causal expressions were included. Therefore, the CDF "Define" and "Explain" were observed more frequently than other CDF.

When the linguistic manifestations of the observed CDFs were analyzed, it was found out that a single CDF was realized through a range of different linguistic patterns. In addition to common linguistic patterns used by all participant lecturers, there were also different usages depending on the style of the lecturer. For a basic generalization, it can be stated that the use of comparative forms of adjectives were the prevalent linguistic structure for the realization of the CDF "Categorize". The CDF "Define" was mainly realized through the use of "Copula be" structure, which could be also named as formal definitions. For descriptions, process descriptions were found to be the most observed type throughout all lectures because there were a number of chemical reactions or physical actions to be narrated. In terms of the realization of the CDF "Evaluate", four adjectives and adverbs (i.e., *important(ly), careful(ly), better,* and *easy/easily*) were observed. The teachers did not include their personal judgments regarding the content. Explanations mainly took place through the use of subordinate clauses, especially with the subordinate conjunction "Because". The teachers mostly used specific verbs like *assume, suppose, think, imagine, guess* and *say* to realize the CDF "Explore". Lastly, the fundamental function of the CDF "Report" in the observed lectures was about presentation of some facts and the results of studies or experiments.

As for the relationship between the use of cognitive discourse functions and the achievement of key competences, it can be stated that cognitive discourse functions play a role in terms of meeting some of the key competences in the observed lectures. Regarding the competences about the introduction of subject-specific terminologies, the CDF "Define" was found to be the dominant one followed by the CDFs "Describe" and "Explain". Concerning the competence which required the presentation of general knowledge about chemistry, the CDF "Report" was also detected in its realization because the teachers generally conveyed general content knowledge through the delivery of facts or referral to research or experiment results

The vast majority of the realizations of the CDFs were done by teachers. Students showed quite a limited participation in the lectures by speaking in English as far as it was observed. When students felt free to speak in their mother tongue, their level of participation was enhanced, and they contributed a lot. This showed that students had a low self-esteem regarding talking in English, which may be because of their affective filters or low level of proficiency in English language.

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5.3.1. Limitations of the study

During the process of data collection, the teachers and students were informed about the study and its data collection procedure as the rules of ethics required. Even though non-participant observation was preferred as the method of data collection and the researcher observed the natural classroom discourse without intervention, the participant teachers might have changed the way they spoke in English, which was labelled as "The observer's paradox" by Labov (1972: p.209). Besides, the lower level of student participation may also have resulted from this because some of the students personally asked me what kind of a study it was and how it would be used. The observation process might have prevented students from actively participating in lessons by speaking in English. Therefore, a detailed analysis regarding the realizers of the CDF could not be done.

Another limitation was that the size of the classroom where L2 was held was too large. L2 was walking around the classroom while he was lecturing and there was no chance for the researcher to do so in classroom settings. Hence, there were some inaudible parts because of the physical distance between the researcher and lecturer.

Regarding the key competences, the length of the term in which the data collected was 14 weeks. However, the observation and data collection period lasted for six weeks. Therefore, all of the key competences of the observed lectures were examined, but the use of CDFs in only two competences in each course was observable. This does not mean that other key competences were not achieved. If the data collection procedure had been longer, there would have been more chance to observe the use of CDFs in the other key competences as well.

The last limitation was that there were a number of equations including lots of numerical and mathematical expressions in the observed lectures as all of them were about sciences. Therefore, there were some inaudible or inexplicable parts in those occasions, which were challenging for the process of transcription.

5.3.2. Pedagogical Implications

Even though the previously mentioned limitations and the lower level of student participation in the observed lectures, this study still yields a number of pedagogical implications regarding the discourse of EMI classes. In the first place, it can be stated that the CDF construct is applicable and observable in EMI lectures referring to the teachers' frequent use of those in the way they deliver the content. That is, how cognitive actions take place in EMI context can be traceable and investigable through the CDF construct offered by Dalton-Puffer (2013, 2016).

As Macaro (2013) suggests teachers are the main stakeholders of EMI education by delivering the content with a language which is not even their mother tongue (p.94). Furthermore, it was observed that the teachers were the key turn takers and discussion guiders in the observed lectures within the scope of the current study. That being the case, teachers' use of language is of significance in terms of

sustaining an effective classroom discourse as teachers' communicative intentions are reflections of their cognition (Dalton-Puffer, 2016: p.32). At this point, teachers' familiarity with the CDF construct is conducive to the achievement of particular cognitive actions. Through CDFs, teachers can convey their cognitive processes to their students, which is crucial for a smooth delivery of content. Therefore, EMI teachers could be provided with some training regarding CDFs to gain familiarity with the construct and modify the way they speak English accordingly.

Even though it was observed that students mostly understood which type of an action they were supposed to take as a response to their teachers' utterances or questions, their participation in lessons by speaking in English was quite limited. When they were asked questions like "What is X?", which requires the activation of the CDF "Define" - and "Why" - which requires the activation of the CDF "Explain", students answered appropriately. Nonetheless, students' productions in English need to be supported and promoted for the sake of a more effective and engaging EMI classroom environment. To this end, lecturers can be informed about the ways to promote students' participation in English such as assigning them to deal with various English-demanding tasks.

Lastly, it was revealed that the CDFs employed by teachers vary depending on the content of the lectures. For example, while explanations occupied the biggest place in the departmental general Chemistry lecture (i.e., *L1*) and Dynamics lecture (i.e., *L4*), it was not the case for the General Chemistry lecture across disciplines (i.e., *L2*), and Physics lecture (i.e., *L3*) in which definitions were observed most frequently. Therefore, it can be stated that there are discipline-based varieties in teachers' use of language. Dalton-Puffer (2013) also states that the investigation of various disciplines could yield different results in terms of the use of CDFs (p.237). Therefore, prospective training programs to inform EMI lecturers regarding discipline-based variations in EMI classrooms may be designed and implemented to sustain an effective EMI classroom discourse.

5.3.3. Further recommendations

It has been observed that the studies in which more than one discipline is examined in terms of the occurrence of CDFs are quite a few. At this point, future studies comparing more than one discipline, especially disciplines belonging to different fields such as social and physical sciences, could be conducted. By this way, discipline-based varieties can be investigated better.

Further studies can also be supported by other data collection and analysis methods. For example, stimulated recalls and focused interviews with both teachers and students can be included so that deeper and detailed conclusions can be drawn. With respect to this, students' use of the CDFs can be focused. Researchers may both observe the CDFs produced by students and have interviews with them to find out whether students are aware of the fact that they are using CDF or not. It can be examined if students can distinguish between a description and explanation or give appropriate answers to questions requiring definitions or explanations. Through this, their familiarity with cognitive discourse functions can be detected and the gap between theory and practice can be revealed, too.

Another important recommendation can be the comparison between different teaching contexts like CLIL and EMI in terms of the use of the CDFs. A vast majority of the studies conducted on the area of CDFs are based on CLIL settings and there are only a few studies regarding EMI context, most of which examine specific CDF, not all of them. Studies comparing these two contexts would be fruitful in terms of revealing how teachers' use of CDFs differs depending on the context in which they deliver their lectures.

The possibility of designing certain training programs for EMI lecturers regarding the use of CDFs was previously mentioned as a pedagogical implication. Before setting up such programs, empirical studies investigating the usefulness of such a training program might be conducted. A group of EMI lecturers can be trained about the CDF construct while other group are not given any training. Then, the improvements of the experiment group concerning their use of CDFs could be

examined, which would be helpful for the planning of potential future teacher-training programs.

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APPENDICES

APPENDIX I.

INFORMED CONSENT FORM

Dear participant:

This study is conducted by Cansu Aykut, who is a student in the department of foreign language education at Kocaeli University, under the supervision of Assoc. Prof. Banu İnan Karagül. The aim of this study is to examine classroom discourse in EMI classes in Turkish tertiary context and present the use of cognitive discourse functions in these classes.

The data of this study will be collected through audio-recording from your class, which will be transcribed later on by the researcher for the purpose of analysis. All of the data collected for the purpose of the study will be strictly kept confidential and used only for the researcher's master thesis. Only the researcher and her advisor are allowed to reach the data.

Participants are free to withdraw from the study whenever they want without stating any reason. Besides, the findings can be shared with the participants if they wish. For any questions, please contact me via cansu.aykut@kocaeli.edu.tr.

Thank you for your valuable cooperation.
Cansu Aykut

"I am informed about the context of the current study. I understand that the data collected from my class will be kept confidential. I give my consent to the researcher to observe my class and collect data through audio-recoding."

Participant's name and surname:
Signature:
Date:

APPENDIX II.

Coding manual for Cognitive Discourse Functions (CDF)

CDF and their codes	Definition	Performative verbs	What kind of sentences can be associated with this function?	Example phrases introducing the function
Categorize (CA)	To arrange in or analyze into classes according to shared qualities or characteristics To provide relevant features or patterns of something so that it can be associated with a more general category	Classify, compare, contrast, match, structure, categorize, subsume	Sentences including categorizations, similarities, and differences among concepts.	*X is a type of Y.* *X is an example of Y.* *X is similar to Y.* *The difference between X and Y is…* *X is bigger/larger/smaller than Y.*
Define (DF)	To state exactly what a thing is; to set forth or explain the essential nature of To set forth or explain what a word or expression means; to declare the signification of a word To make a thing what it is; to give a character to To separate by definition, to distinguish special marks or characteristics	Define, identify, characterize	Sentences including a definition of a specific concept especially with its distinguishing characteristics and the category to which it belongs	*X is Y.* *X is called Y.* *X is a type of Y that/which ...*
Describe (DS)	To set forth in words, written or spoken, by reference to qualities, recognizable features, or characteristic marks. To give detailed or graphic account of something	Describe, label, identify, name, specify	Sentences including observable characteristics of something (e.g., Physical description) parts of something constituting the whole (e.g., Structural), usage areas of	*In the middle of the center.* *Next to it/Near/between. ..* *X is a part of Y.* *The first step is...* *Firstly/Secondly*

			something (e.g., Functional) , steps to complete something (e.g., Process).	*/Lastly...* *We use X for...*
Evaluate (EV)	To determine the value or estimate the force of something in terms of something already known	Evaluate, judge, argue, justify, take a stance, critique, recommend, comment, reflect, appreciate	Sentences including stance-taking to justify something or argue opinions, commenting or reflecting.	*It is better to use X* *Be careful about X.* *X is very important.* *X is not easy.*
Explain (EA)	To give an account of one's intentions or motives To make clear the cause, origin, or reason	Explain, reason, express cause/effect, draw conclusions, deduce	Sentences answering the question "why?" and having a causal notion.	*Why do we do that? Because...* *X does this so…* *X does this, as a result…*
Explore (EO)	To state a proposition merely as a basis for reasoning or argument that is, without conclusive evidence	Explore, hypothesize, speculate, predict, guess, estimate, simulate, take other perspectives	Sentences including assumption, predictions, hypotheses, personal interpretations, reasoning and referral to possible results of a situations under certain conditions.	*Let's think/say/assume/imagine…* *(so) what would happen... (if)* *What would you propose...?* *What would happen if…?* *What would you do if what happens if...* *Anyone want to take a guess?* *Can you predict...* *What would your prediction be?*
Report (RE)	1. to provide or convey information a. to give an account of (a fact, event, person,) to	Report, inform, recount, narrate, present, summarize, relate	Sentences including revisions, retelling main points, presenting findings of a study, referring to	*We looked at X.* *Experiments show that...* *I/we reviewed X.*

	relate, recount, tell; to describe 2. a.to repeat (something heard); to relate as having been spoken by another; to retell b. to convey, impart, pass on (something said, a message, etc.) to a person as knowledge or information 3. to relate, state or bring in (information or intelligence discovered), esp. as the result of an investigation; to give a notification of (something observed)		a previous topic or wrapping up/summarizing the central concepts topic (esp. With past tense) can be analyzed under the category of "report".	*I/we told you.* *I/we said that...* *X says that...* *I/we observed/discovered that...* *In ancient times, people did not know that…*

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2019 – present	Research Assistant Kocaeli University - Foreign language education department
2018 - 2019	English Instructor İstanbul Bilgi University
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PROJECTS

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PUBLICATIONS

Aykut, C. (2019, November). *Gender-related linguistic differences: The case of English teachers working at a foundational university in Turkey.* Paper presented at International Marmara Social Sciences Congress (IMASCON). http://imascon.com/dosyalar/imascon2019guz/imascon_sosyal_ bildiriler_guz_2019.pdf

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