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Exploring cognitive discourse functions for disciplinary literacies in university EMI programs

Abstract. This study investigates the integration of Cognitive Discourse Functions (CDFs) in English-Medium Instruction (EMI) classrooms across various disciplines in Turkish higher education, with a particular focus on teacher education programs. CDFs provide a systematic framework for analysing how language facilitates cognitive processes such as describing, explaining, evaluating, and categorising in disciplinary contexts. The data comprise 472 minutes of lesson recordings from five courses across three fields: Computer Education and Educational Technology, English Language Teaching, and Mathematics and Science Education. Lessons were analysed using CDF coding to examine field-specific variations in language use and their implications for disciplinary literacies. The study provides an initial exploration of the interconnectedness of CDFs with disciplinary literacies by delineating their role in building foundational knowledge, facilitating reasoning, and fostering critical thinking. These findings indicate that explicit integration of CDFs into EMI pedagogy has potential for addressing language and content challenges faced by students in EMI settings. The article contributes to the growing body of research on EMI by providing insights into the interplay between language and disciplinary knowledge construction.

Keywords: cognitive discourse functions, disciplinary literacies, higher education, English-medium instruction.

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1. INTRODUCTION

English-medium instruction (EMI) is widely practiced at the tertiary level in Türkiye. As in Europe, Asia and the Middle East (Macaro et al. 2018), higher education institutions in Türkiye, especially the growing number of (foundation) universities (i.e., owned and operated by foundations), are increasingly offering programs in English. While conceptualizations and practical applications of EMI vary, the often-cited definition by Dearden (2015: 4) aligns well with the Turkish context: "The use of the English language to teach academic subjects in countries or jurisdictions where the first language (L1) of the majority of the population is not English".

When local and international student profiles are considered (Gülle et al. 2024), it is evident that English is a second language (L2) for the majority of students enrolled in tertiary-level EMI programs in Türkiye. While the implementation of EMI in Türkiye is driven by governmental and institutional strategies (Gülle et al. 2024), research indicates that students experience various language-related challenges in their studies (British Council & TEPAV 2015; Kırkgöz 2005).

Given EMI's primary focus on delivering subject content, with the development of English language skills often relegated to a secondary position (Pecorari & Malmström 2018), it seems that a recalibration in the language-content interface is needed in EMI. This new approach can be informed by decades of research in Content and Language Integrated Learning (CLIL), in which the concurrent development of content knowledge and language skills is prioritized (Coyle et al. 2010). While Chang's (2023: 163) proposal of "CLIL-ised EMI" provides a promising pathway, frameworks for content and language integration with (increased) explicit attention to disciplinary language are still needed in EMI.

In this respect, the Cognitive Discourse Functions (CDFs) Framework, developed by Dalton-Puffer (2013), provides one systematic way to identify and scaffold the specific language demands associated with disciplinary learning and teaching (Dalton-Puffer 2013). CDFs represent the ways language is used to perform cognitive tasks such as *defining*, *explaining*, *categorizing*, or *exploring* (Dalton-Puffer 2013), which are essential in academic discourse. The framework also functions as an accessible tool for analyzing language requirements in instructional materials, assessment activities, and daily classroom interactions (Dalton-Puffer et al. 2018).

This study is situated at the intersection of EMI and disciplinary literacies, aiming to explore how CDFs operate across different fields in teacher education programs. The specific aim of this paper is twofold:

i. To investigate how CDFs are realized in EMI courses in Turkish higher education across diverse fields (i.e., Computer Education, English Language Teaching, Mathematics and Science Education);
ii. To examine the pedagogical implications of CDF use for developing disciplinary literacies, thus contributing to discussions on content and language integration in EMI.

Based on CDF analysis of EMI content lessons, we discuss how a CDF-aware pedagogy can help learners navigate discipline-specific knowledge construction and communication in an L2.

2. LITERATURE REVIEW

In this section, we review research on EMI with a particular focus on Türkiye, and then provide a brief overview of CDFs and disciplinary literacy.

2.1. EMI in Türkiye

The rapid rise of EMI in Türkiye has been accompanied by several challenges. Kırkgöz (2014) reports that students at a Turkish state university face difficulties in comprehending disciplinary content, grasping specific details, managing the time-intensive nature of EMI, and understanding exam questions. More recently, students have expressed dissatisfaction with their inability to effectively follow EMI lessons (Karakaş 2017).

Previous studies reveal that English proficiency and prior content knowledge are significant predictors of content attainment (Aizawa et al. 2025). EMI programs often lack an explicit focus on the interplay between content and language learning, and students are usually left to address language challenges on their own (Breeze & Dafouz 2017; Dafouz & Smit 2016). Yıldız et al. (2017) reveal that students have difficulties in following their departmental courses even after completing the English preparatory program. The authors note that students expressed the need for "a curriculum specifically based on English for a specific academic purpose" to improve their discipline-specific technical vocabulary knowledge (Yıldız et al. 2017: 395). These findings echo those reported in other contexts, for instance in a study of a Japanese university, where Aizawa et al. (2025) drew attention to the importance of subject-specific language support.

Wingate (2018) argues that academic literacy should not be seen as a set of generic, transferable skills but as socially situated practices that vary across

disciplines. She suggests embedding literacy instruction within subject teaching rather than isolating it in stand-alone remedial courses. She also highlights the need for collaboration between language specialists, disciplinary faculty, and support staff to integrate academic literacy development into curricula (Wingate 2018). In relation to this latter point, Dearden et al. (2016) examined how collaboration between English language instructors and EMI teachers from diverse backgrounds can shape the delivery of content in higher education EMI settings in Türkiye. They reported positive results of collaborative lesson planning based on language teacher and content teacher accounts. While such collaboration enhances the pedagogical design of EMI courses, students' success in EMI also depends on their mastery over disciplinary discourse. This knowledge allows them to create discourse that aligns with the expectations and norms of the respective disciplinary culture (Airey 2020). In other words, learning in tertiary-level EMI is closely associated with developing literacies in disciplines.

2.2. Disciplinary literacies and cognitive discourse functions

Disciplinary literacy is a multifaceted concept that integrates various elements such as academic discourse, the use of multilingual and multimodal resources, discipline-specific language and semiotics, digital competencies, and critical thinking (Nikula et al. 2024). The development of disciplinary literacy begins with the adaptation of disciplinary content in primary and secondary education and continues through specialized courses delivered by experts in higher education (Dalton-Puffer et al. 2024). The nature of disciplinary literacies can, therefore, be argued to be different in higher education, as a reconceptualization of disciplinary knowledge for schooling is not as substantial as it is in pre-tertiary educational levels and the content is delivered by experts who are, in most cases, more involved in knowledge production through research than is the case in pre-tertiary level. However, in higher education, too, there is a need for explicit teaching of discipline-specific language features to help students effectively engage with disciplinary discourse (Airey 2020). This task can be approached through the integration of CDFs as a useful framework for understanding the discipline-specific linguistic demands of EMI.

Theorized by Dalton-Puffer (2013), the CDFs Framework offers a categorization of the cognitive functions that are used and/or required in different disciplines. Dalton-Puffer et al. (2018) state that the CDF construct is based on two key principles. First, conscious understanding of the world, as addressed

in formal education, is inherently shaped by language, serving as the medium through which learners internalize (new) meanings about the world. Second, language is the primary tool for learners to communicate their existing or newly formed perspectives to others. This implies that classroom interactions are shaped by curricular objectives (Dalton-Puffer et al. 2018).

CDFs organize the diverse terms used for linguistic actions required to meet curricular objectives into seven fundamental categories, referred to as CDF types (Dalton-Puffer et al. 2018). Each type is grounded in a specific communicative purpose or intention, which is manifested as teachers and learners engage in activities such as comparing, specifying, hypothesizing, or recounting during teaching, learning, and assessment (Dalton-Puffer & Bauer-Marschallinger 2019). Table 1 presents the list of functions together with their communicative intentions.

Table 1. Types of Cognitive Discourse Functions

Label	Communicative Intention
CLASSIFY	I tell you how we can cut up the world according to certain ideas.
DEFINE	I tell you about the extension of this object of specialist knowledge.
DESCRIBE	I tell you details of what can be seen (also metaphorically)
EVALUATE	I tell you what my position is vis a vis X.
EXPLAIN	I give you reasons for and tell you cause/s of X.
EXPLORE	I tell you something that is potential.
REPORT	I tell you about sth. external to our immediate context on which I have a legitimate knowledge claim.

Source: adapted from Dalton-Puffer (2013: 234).

As Doiz and Lasagabaster (2021: 59) suggest, CDFs "would provide both content and language teachers with a framework with which to approach the integration of content and language, as they could use it as metalanguage to talk about what takes place in EMI classes". CDF-based studies across disciplines have generated important results. For example, Doiz and Lasagabaster (2020) investigated whether, and in what ways, CDFs play a role in facilitating the development of historical competences. The results indicated that teachers often employed complex CDFs, integrating various discourse functions to achieve their communicative objectives and support students in acquiring competences in history. The most commonly observed CDFs were DESCRIBE, utilized for narrating historical events; EXPLAIN, which addressed causes, reasons, and

consequences of specific topics; and DEFINE for definitions of discipline-specific terms. Another frequent CDF turned out to be EVALUATE, by way of which the teachers encouraged critical thinking among students and exposed them to multiple perspectives.

Evnitskaya and Dalton-Puffer (2023) investigated how students in a CLIL program realized CATEGORIZE during verbal interaction in history and science subjects. The researchers also compared students' use of CATEGORIZE in their L1 Spanish and L2 English. The results showed that two sub-categories of CATEGORIZE, classifying and comparing, were differently distributed in the science and history subjects. Students predominantly used classification in science topics while they usually made comparisons in the case of history. It was also revealed that that learners struggle with both conceptual and linguistic aspects when attempting to form proper classifications in both languages. However, these difficulties vary in nature and intensity. Surprisingly, despite differences in lexical richness, the complexity of the concepts and ideas articulated by learners in their L1 and L2 were similar (Evnitskaya & Dalton-Puffer 2023).

In the Turkish context, Aykut (2021) analyzed CDFs in EMI programs at Chemistry and Physics departments in two state universities, and found EXPLAIN and DEFINE to be the most commonly occurring CDFs. This finding was mainly attributed to the nature of the courses, where the terminology was new to the learners and therefore needed to be defined to familiarize the learners with new concepts, and the content required causal explanations. While this attribution points, once again, to differences in disciplinary discourses, it was also found that there were differences at the course level, as was shown, for example, by the variations in the distribution of CDFs in two general Chemistry lectures (one for students in the Chemistry department, and the other for students from different science departments) (Aykut 2021).

CDF-based studies are rare at the tertiary level, and little attention appears to have been given to courses offered in pedagogical programs. Our study aims to address this gap by investigating the use of CDFs in five different courses offered in the programs of English Language Teaching, Science and Math Teaching, and Computer Education at the tertiary level, providing insights into their role and relevance in teacher education contexts.

3. METHODOLOGY

CDF analysis offers insights into how students and teachers use L2 in various disciplinary environments as appropriate to the specific requirements of each

field. The results obtained through CDF analysis can have considerable practical implications for the content classroom (Dalton-Puffer et al. 2018).

Within the scope of the study, the lessons from five courses offered in different programs within the Faculty of Education at a state university in Türkiye were recorded and analyzed using the CDF framework: COMP-1 from the Computer Education and Educational Technology program, FLE-1 from the English Language Teaching program, and Math and Science courses (i.e., MATH-1, SCIENCE-1, SCIENCE-2) from the Mathematics and Science Education program. These courses were chosen for disciplinary variation. While some courses were recorded only once (e.g., COMP-1, SCIENCE-1), others were recorded in two sessions (e.g., MATH-1) or four sessions (e.g., FLE-1, taught by two teachers, and SCIENCE-2). The six teachers offering these courses were chosen based on their willingness to participate in the study, as well as considering their experience in offering the courses. All the lessons were conducted online due to the COVID-19 pandemic. The lesson recordings were transcribed and coded by three of the authors. CDF analyses were performed independently by each researcher, following the CDF-analysis manual developed by Rieder-Marschallinger and Minardi (2024). The manual provides key points regarding the distinction between CDFs, providing examples for each. Then, the researchers cross-checked each other's work, and any discrepancies were resolved through discussions. A total of 472 minutes of lessons were analyzed (see Table 2). This analysis reveals the types and distribution of CDFs across lessons, the purposes for which teachers perform CDFs, and the linguistic realizations of CDFs.

4. RESULTS

The findings obtained from the study are reported below.

4.1. Occurrences of CDFs across disciplines

First, the analysis produced several numerical findings. The number of CDFs observed in the examined courses is presented in Table 2. The numbers listed under each CDF correspond to the number of observed episodes within each course. As these numbers are not normalized for duration, they should be interpreted accordingly.

Table 2. Distribution of CDFs by courses

Course	Instructors	Duration	DS	CA	DF	RE	EO	EA	EV
COMP-1	T1	32′	26	19	18	15	14	7	6
FLE-1	T2	80′	82	17	2	80	66	33	55
	T3	80′	78	8	1	44	48	21	41
MATH-1	T4	80′	75	39	13	22	56	70	55
SCIENCE-2	T5	160′	143	38	23	151	65	71	121
SCIENCE-1	T6	40′	27	16	1	7	4	12	16

Notes: DS: DESCRIBE, CA: CATEGORIZE, DF: DEFINE, RE: REPORT, EO: EXPLORE, EA: EXPLAIN, EV: EVALUATE; T: Teacher; COMP-1: Information Systems in Education and Information Design; FLE-1: Critical Thinking into Academic Writing; MATH-1: Teaching Mathematics in Primary Education; SCIENCE-2: Science, Technology, and Society; SCIENCE-1: Academic Orientation to Mathematics and Science Education.

As shown in the table, DESCRIBE and REPORT tend to be used frequently across fields. On the other hand, EXPLORE, EXPLAIN and EVALUATE functions are used frequently in some courses and occasionally in others. CATEGORIZE and DEFINE functions are observed less often than the other functions.

Figure 1 shows the distribution of CDFs according to different fields, grouped into computer education and educational technology, foreign language education, and mathematics and science education.

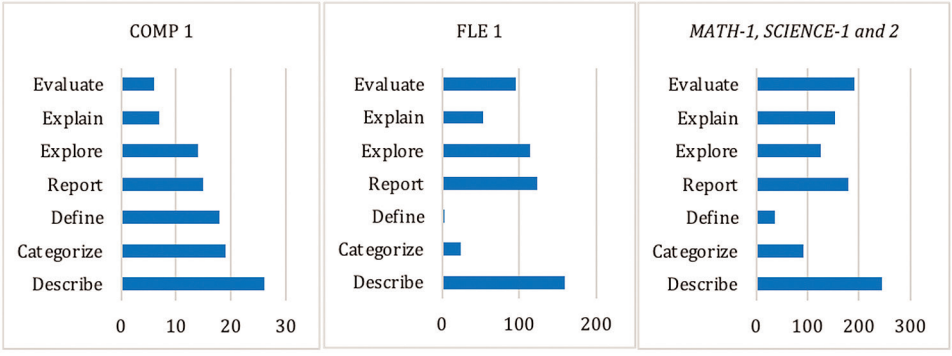

Figure 1. Distribution of CDFs in the courses observed

Source: own study.

As shown in Figure 1, DESCRIBE is the most frequently used function in COMP-1, while EXPLAIN and EVALUATE appear to be the least often used CDFs. In FLE-1, the teacher frequently used descriptions. The majority of these

descriptions occurred in the form of describing situations, events or people mentioned the reading text that was the subject of the lesson. REPORT was also common, largely because the teacher often referred to external sources. DEFINE was a rarely used function. As for mathematics and science education, the most frequently used CDFs were DESCRIBE and EVALUATE. While the frequent description of scientific phenomena is expected, the prominence of EVALUATE is more surprising. Closer examination reveals that the lessons focused on topics such as logic, logical inferences, and ethics. Therefore, the teacher frequently made evaluations on issues such as the validity of various logical inferences or the ethicality of various scientific experiments. This indicates that the distribution of CDFs may vary not only by field but also by topic.

4.2. Realizations and pedagogical roles of the CDFs

In this section, we present realizations and pedagogical functions of CDFs in different courses.

4.2.1. Realizations of the DESCRIBE function

Bauer-Marschallinger (2022: 298) specifies that in history lessons, the DESCRIBE function is realized as "expressing the details of what we can observe based on historical sources and materials." In the current study, DESCRIBE was observed as the most commonly occurring function across all fields. In all classes, DESCRIBE was frequently used to present the context and significance of content introduced in the resources that were readily accessible. Such content was signposted through expressions such as "It says that," "here he explains," and "he feels like". In the FLE-1 course, for example, the phrase "Here the police officer is speaking, right?" implies directly referencing quotations from a primary source. These expressions not only realize DESCRIBE but also demonstrate its integrated relationship with present and observable materials and phenomena for students. The mediatory role of materials in content delivery gains importance, particularly regarding how the topic is expressed in these materials. For example, the arrival of modernism is described by reference to the eloquent expression of Austin, as it appears on the material, i.e., "As Austin said, modernism is knocking on the door". In the same course, DESCRIBE was also used to present vivid representations of experiences through expressions such as "hated by large numbers of people" and "anti-European feeling was very bitter." This language captured the emotional and social atmosphere surrounding Orwell's experiences.

In mathematics education, DESCRIBE was predominantly used in declarative statements to provide information about concepts, processes and procedures related to mathematics and its applications. For example, the sentence "From scientific data collection through experiments and observations, we come up with large sets of data" describes the data processing procedure.

Rieder-Marschallinger and Minardi (2024: 2) define the operationalization of the DESCRIBE function in science as "visualizing the nature of something by specifying its main features and essential qualities." Similarly, in science courses examined in the study, the "nature" of the content was also frequently emphasized through DESCRIBE (e.g., "This electrode is connected to the shock generator in the next room"). DESCRIBE was often preceded by phrases directing students' attention to the teaching materials such as "these operational activities," "in this waterfall approach," "as you can see," "here in this figure," and "let's see in this graph." These expressions helped draw focus on the concept or process being introduced through the materials.

4.2.2. Realizations of the EXPLAIN function

In many instances, EXPLAIN was used to discuss the reasons behind actions or events in a causal language. In SCIENCE-2, expressions such as "because they didn't tell people what their disease was," "because Nazis... they were thinking that they are subhuman," and "to investigate hypothermia" indicate the reasons or purposes behind certain actions or events. Similarly, in the MATH-1 course, the reasons behind certain student behaviors that are commonly observed during mathematical operations were expressed through EXPLAIN. Examples such as "So they [students] try to count because they used to count things over here" or "That's one reason why we don't think that way in routine strategies of counting" were typical in the math course. In science classes, the EXPLAIN function was used to present the purpose of and motivations behind experiments. For example:

- [EA: I mean (EV: they did a lot of horrible things) but this is just, these are just some examples (EA: submerging people to very cold water to investigate hypothermia)] (T5),
- (EA: trying little injections on people to see what chemical kills a person faster, right.) (T5),
- (EA: to understand what happens if the pilots were shot.) (T5).

Similarly, in FLE-1 lessons, the conjunction "because", which indicates a cause-effect relationship, was frequently used in expressions that perform EXPLAIN. In certain examples, EXPLAIN was used to justify a specific situation.

For example, T3 explained that a character in the novel could not name his feelings because he had suppressed these feelings for a long time:

- (EA: And at the same time, why can't she, you know, name what she was feeling? Because these kinds of feelings were the things that she has suppressed for so long actually, right?) (T3)

On the other hand, in some cases, generalizations were reached based on specific events in the novel, and the teacher provided reasons for these generalizations. For example:

- (EA: So these are really quite, you know, controversial to what would be expected in a normal case and, you know, a normal situation, let's say, right. Because, I mean, people who are sad generally are expected to, you know, console themselves in the arms of others.) (T3)

4.2.3. Realizations of the CATEGORIZE function

Sentences that fulfill the cognitive function of CATEGORIZE often use language related to classification and grouping. In mathematics and science education courses, expressions like "the teacher knowledge can be classified under three categories" and "the first category being the content" explicitly indicate categories and subcategories. Sentences with CATEGORIZE included sequential language to organize categories or types of knowledge. Phrases like "the first category being," "The next kind of teacher knowledge," and "the third kind of knowledge" illustrate this sequential organization. In some cases, CATEGORIZE was used to make comparisons and distinctions between educational practices and types of knowledge. For instance, expressions such as "it has gone from simple to complex" and "a lot harder exams than the US does" provide comparisons across time and countries, respectively. Lastly, as observed in the SCIENCE-2 course, expressions like "better than" and "distinguish" were used to compare and classify arguments or observations based on their attributes. The example below illustrates how a DESCRIBE episode can incorporate multiple CATEGORIZE functions:

- [DS: We have courses in pedagogy that is for instruction, instructional materials in the COMP-1 course and special education needed for every teacher. (CA: So it's more of a pedagogy. But then our junior year, the third year of our program begins to focus more on pedagogical content), that is how to teach mathematics and specifically how to teach probability and statistics, how to teach geometry, etcetera. (CA: So we go on to more pedagogical content and in our final year), we have the measurement course, classroom management course. (CA: Those are pedagogy courses. But

again, in our other courses we specifically focus on mathematical content or how to teach. So it's pedagogical content knowledge.)] (T6)

In FLE courses, CATEGORIZE was less commonly used. When it did appear, it was often employed for comparison rather than classification, which was closely tied to the content of the topic being addressed. For example, when T3 discussed the topic of colonization, they first made a classification of "oppressed" and "oppressor":

- (CA: They both have internalized the roles being the oppressor and the oppressed.)

Building on this classification, they made various comparisons between the two groups, expressing how different cultures share certain characteristics while differing in others. For instance:

- (CA: People are somehow similar. They want meats. Yes, the two cultures are somehow similar.) (T3)
- (CA: Burmese people are not different from Europeans in that sense.) (T3)

In these examples, CATEGORIZE is conveyed not through specific grammatical structures but through the use of words like "similar" and "different" (although word choices naturally influence the grammatical structures).

4.2.4. Realizations of the EXPLORE function

EXPLORE includes unrealistic or speculative ideas or a temporary solution for a problem/situation. In FLE-1 lessons, this function was often used through questions. As seen in the questions below, students were asked to come up with ideas and/or solutions for issues that do not have a definitive and clear answer or where finding such an answer is not intended, as is implied by the use of the word 'think' and the modal verb 'can'.

- (EO: How can we fix maybe the problem of homelessness? Or what can we do about maybe minimizing the role of corporate companies in global warming?) (T2)
- (EO: Can anybody say that's a metaphor that is giving name to this model?) (T1)
- (EO: What do you think she's criticizing here?) (T3)

In the expression of EXPLORE, non-definite words/modal verbs such as 'maybe', 'imagine', 'I think', 'may/may not' were frequently observed. In FLE-1, sentences with EXPLORE frequently used hypothetical language indicated by expressions such as "maybe", "if" and "imagine yourself". In this way, students were invited to consider various scenarios, possibilities or outcomes. In addition, expressions such as "maybe he was influenced," "maybe his situation is quite

hard," and "maybe you find these students rightful" reflect an exploratory approach in which the speaker considers different possibilities and perspectives.

Similarly, since this function also includes speculative discourse, sentences formed with the word 'if' were often used in the verbal expression of this function. In 'if' sentences used in hypothetical situations in English, the modal verb 'would' is used to express the possible outcome of a speculated situation. Therefore, 'would' was also a frequently encountered modal verb in the verbalizations of EXPLORE. Two examples taken from FLE-1 and SCIENCE-2, respectively, are as follows:

- (EO: If you know the you know the ills or evil plans of colonialism or imperialism, one would expect you to take side of the colonized people then.) (T3)
- (EO: Of course you can ask them like what will you do if you are in this kind of situation, you know, I mean they they would probably tell you that no they will not continue if they hear screams or or like that, right?) (T5).

4.2.5. Realizations of the REPORT function

Bauer-Marschallinger (2022: 298) defines the REPORT function as "expressing things that exist outside the current context, i.e., things not observable in the resources/materials at hand but legitimately known." In our data, many sentences with REPORT involved transferring information from a source or attributing the information to a source. For example, in FLE-1, expressions such as "it was during the British Empire," and "a song that I remember" indicated that the information was being conveyed from another source or personal memories. Phrases like "During the British Empire" and "the monks at that time in Myanmar" also referenced historical or contextual information. This positions the reported information in a specific historical or cultural framework.

In the following example from SCIENCE-2, T5 recounts an event from the past and, while reporting it, also provides a personal evaluation:

- [RE: The doctors and scientists from Nazi Germany during the Second World War performed (EV: many horrible, gruesome experiments with people in the prisons and in the concentration camps.)] (T5)

Similarly, in FLE-1, when performing REPORT based on a source that was not accessible in the classroom setting, the type of the source material was often specified. For instance, expressions like "but generally, in a traditional academic text" (T2), "I've recently seen some news that Poland is also doing the same" (T2), and "when we watch some historical films" (T3) identify the source as, respectively, "an academic text," "news," and "films."

REPORT was also used to relate new information being conveyed to students' prior knowledge. For instance, in MATH-1, the teacher connected the new topic to examples from previous lessons using expressions such as:

- (RE: Remember the examples we discussed in the previous lesson where the student's problem was the division.) (T4)
- (RE: Remember the examples that I was telling to you the other day while discussing subtraction.) (T4)

A similar usage appeared in FLE-1 through a question posed by the teacher: "Have you guys discussed this before in FLE-X, hedging who heard the term before? Sometimes I also left a comment like 'consider using hedging or consider using a more hedged structure' into your essays." In these instances, the teacher integrates the new content into a known context, to make it more comprehensible for students.

4.2.6. Realizations of the EVALUATE function

Many statements containing evaluations were found to use adjectives to convey this cognitive function. For example, "important," "unethical," "barbaric," and "brutal" were used to evaluate the nature of actions or issues. Sometimes, emphatic language emphasized the intensity of such evaluations, e.g., "simply a racist project," and "it was unethical. It was brutal. It was barbaric". Such evaluations were sometimes accompanied by expressions of an emotional response, as in "it makes a person uncomfortable". Similarly, some statements containing EVALUATE included comparative or superlative forms to emphasize the seriousness or extremeness of the event or issue, such as "very unethical" and "most interesting".

In mathematics and science education courses, it was observed that some evaluations involved comparison between different elements or perspectives. For example, one statement was, "practice is not important, but the other one is more important" and "it's important to talk about those in Turkish context", not with "United States perspective." Here, the relative value or appropriateness of different approaches was evaluated. Also, it was observed that evaluations can be both direct (e.g., "this is very important") and indirect (e.g., "they need to see it instead as a subject in which things fit together logically").

In SCIENCE-1, evaluative discourse was often marked by judgments. For example, "this was a good summary," "That's a very good explanation," and "which is really weird" provided evaluations about the quality or appropriateness of certain elements.

4.2.7. Realizations of the DEFINE function

DEFINE is realized through statements that include the extension of a concept or phenomenon of specialized knowledge (Dalton-Puffer, 2013). DEFINE appeared infrequently across courses. For instance, the following example from MATH-1 includes a description followed by a definition:

– (DS: we're trying to diagnose what's happening over there) and (DF: that's called diagnostic teaching.) (T4)

In this example, T4 described an action and immediately followed it by specifying what the described action is named.

Regardless of the field, DEFINE in the observed courses was used to express the meanings of terms that were (assumed to be) new to the students. The statements "Stakeholders are the ones who are involved in the project, you know, including the project team and also the ones who will be affected by the outcome of the project," "That comparison, the amount of time to the amount of a place that you go, we call them as a speed," and "So hedging basically means to be more cautious using some words giving probability to what you are saying" are definitions provided by teachers in mathematics, educational technology, and language education courses, respectively.

In SCIENCE-2, DEFINE was observed to primarily revolve around the concepts of logic, reasoning, and argumentation in line with the nature of the course content. Terms such as "Perfectly valid arguments," "inductive reasoning," and "inductive arguments" were central to these definitions. Some definitions included examples to clarify points, such as "the first premise is all cats have five legs," an intentionally absurd example given to discuss logical validity.

4.3. Aspects of disciplinary literacy

To explore the interconnectedness between CDFs and disciplinary literacies with a specific focus on how CDFs align with various aspects of literacy within disciplines, we examined the disciplinary purpose served by the use of specific CDFs. Table 3 illustrates how each CDF relates to different aspects of disciplinary literacies.

Table 3. Aspects of disciplinary literacy and associated CDFs

CDF	Disciplinary Purpose & Aspect of Literacy	Examples in FLE	Examples in SCIENCE	Examples in MATH
DESCRIBE	– Lays foundational knowledge by providing concrete details and context – Aids in recognizing key phenomena, events, or elements within a discipline	– Contextualizing historical and literary events (e.g., describing a setting or character) – Orienting students to cultural or textual details	– Introducing scientific tools, processes, or phenomena (e.g., describing a "shock generator") – Using visual aids like graphs, figures	– Describing mathematical objects, diagrams, or scenarios before deeper analysis
DEFINE	– Clarifies key terms and concepts – Establishes precise disciplinary vocabulary	– Clarifying terms in literary or cultural texts (e.g., historical references)	– Specifying domain-specific terminology (e.g., "inductive reasoning") – Enhancing precision with specialized scientific vocabulary	– Articulating discipline-specific concepts (e.g., "speed") – Defining fundamental mathematical or pedagogical terminology
REPORT	– Draws on prior knowledge or external sources – Contextualizes new information within a broader disciplinary or real-world frame	– Linking new content to previous lessons, cultural artifacts, or historical facts – Citing external sources (e.g., "I've recently seen news…")	– Referencing previous lessons or facts to build continuity – Integrating personal anecdotes or known historical/ scientific events	– Recounting prior problems to set the stage for new content
EXPLAIN	– Fosters disciplinary reasoning by articulating causes, motivations, or justifications – Develops students' capacity to understand "why" or "how" within a discipline	– Clarifying motivations behind characters' actions – Unpacking cultural or historical reasons for events	– Describing cause-and-effect relationships (e.g., why certain experiments are conducted) – Explaining reasoning behind scientific procedures	– Explaining the rationale behind proofs, steps in problem-solving, or pedagogical decisions

EVALUATE	– Encourages critical judgment and comparison of ideas or practices – Builds interpretive and analytical skills	– Assessing moral/cultural dimensions (e.g., "very unethical," "brutal") – Prompting interpretive debates in literary/historical contexts	– Comparing alternative theories or practices (e.g., different research methods) – Analyzing data or hypotheses in a critical manner	– Critiquing pedagogical methods or curricular materials
CATEGORIZE	– Organizes and structures knowledge – Develops taxonomic or comparative frameworks	– Less frequent but used in comparing cultural roles (e.g., "oppressor" vs. "oppressed") – Using comparative language to note similarities/ differences	– Classifying teacher knowledge or scientific ideas (e.g., "three categories…") – Introducing hierarchical or sequential structures	– Not identified in the data
EXPLORE	– Encourages hypothetical, speculative, or inquiry-based thinking – Cultivates advanced literacy by prompting students to generate, test, or imagine possibilities	– Using open-ended questions (e.g., "If you were in this situation…") – Stimulating students to consider multiple perspectives	– Posing "What would happen if…" scenarios in experiments or problem-solving – Encouraging predictive and experimental thinking	– Hypothesizing about potential solutions or strategies – Fostering inquiry into mathematical patterns or proofs

Source: own study.

5. DISCUSSION

The findings illustrate the intricate relationship between CDFs and disciplinary literacies in EMI contexts, as different CDFs are used to address different cognitive and linguistic demands of various disciplines, and their distribution varies depending on the subject matter.

With regard to DESCRIBE and REPORT functions, Dalton-Puffer et al. (2018: 17) state that DESCRIBE serves to provide "perceptions of the various objects of learning in order to establish an intersubjectively validated 'state of affairs'

… which can then serve as the basis for further work", and REPORT to "frame the in-depth treatment of a new topic" (Dalton-Puffer et al. 2018: 12). Our data indicate similar functions, as DESCRIBE was consistently used to present fundamental concepts and provide concrete details before moving on to more complex disciplinary content, while REPORT was employed to reference prior knowledge and external sources. REPORT is conceptualized, with specific reference to history, by Bauer-Marschallinger (2022: 299) as relating to "re-construction competence or narrative competence, as the elements previously extracted from historical materials should now be comprehensively and reasonably combined into one historical narrative". In our data, too, REPORT appears in statements drawing on subject-matter-related sources not immediately present in the class (e.g., "I've recently seen some news that Poland is also doing the same"), and the teacher reconstructs the content of the source from memory. This serves to bridge newly introduced content with existing knowledge frameworks. In both FLE and SCIENCE courses, teachers frequently used REPORT to refer to prior lessons, historical facts, cultural artifacts, or personal anecdotes. Such practices can contribute to students' ability to consider the origin of information and evaluate its relevance or credibility.

The prominence of EXPLAIN and EVALUATE in science and mathematics education reflects the emphasis on causal reasoning and critical evaluation within these disciplines. This finding is partially consistent with studies by Aykut (2021: 125) where it is stated that in EVALUATE "There was no place for personal judgments and interpretations in all of the observed lessons because they were all about physical science classes.", which implies a focus on analytical and non-subjective thinking in STEM fields. The frequent use of EXPLAIN to articulate causal relationships in SCIENCE courses aligns with the observation that EXPLAIN is a key function in scientific inquiry. Similarly, the use of EVALUATE in mathematics education, where teachers talked about relative importance of the subject matter being taught, resonates with Aykut's (2021: 125) findings, which show that EVALUATE serves to "emphasize the importance […] of some topics". These functions require students to practice causal logic, justification, and critical judgment. In SCIENCE courses, EXPLAIN was used to articulate causal relationships and to justify or motivate actions, and EVALUATE emerged when comparing alternative theories or practices. In FLE courses, EXPLAIN functioned to clarify motivations behind characters' actions, and EVALUATE involved emphatic language ("very unethical," "it was brutal") to assess moral and cultural dimensions, an aspect of interpretive and critical literacy in humanities and social sciences (Luke 2012).

CDFs were also used for inquiry, speculation, and hypothesis. EXPLORE occurred in questions and hypothetical scenarios that prompted students to

imagine, predict, or propose solutions, as well as to pose and examine multiple perspectives. This finding aligns with what Doiz and Lasagabaster (2021) observed in the area of history. They observed that EXPLORE was used when one of the teachers encouraged students to make predictions regarding situations, by which he aimed to help them better comprehend the historical event under focus. Similarly, we observed that EXPLORE fosters disciplinary literacy by prompting students to consider alternative perspectives and generate hypotheses. For instance, in FLE-1, open-ended questions and speculative scenarios invited students to consider various outcomes. Similarly, in SCIENCE courses, EXPLORE was used in speculative questions such as, "What would happen if…?" to stimulate predictive and experimental thinking.

The findings indicate that CDFs also serve the disciplinary/pedagogical purpose of helping students see how concepts or entities are grouped or distinguished. The use of CATEGORIZE, though less frequent overall in our data, helps organize knowledge into hierarchical structures. As Evnitskaya and Dalton-Puffer (2023: 312) point out, "categorization plays a pivotal role also in the generation of systematic, scientific or expert knowledge" and also helps learners to be introduced to and understand "the logical hierarchies and formal classification systems that characterize systematic expert knowledge." Therefore, CATEGORIZE is integral to structuring disciplinary knowledge. For example, in science courses, teachers classified types of knowledge or phenomena to aid conceptual understanding. While categorization was observed less frequently in FLE courses, it still emerged, for example, in comparisons of cultural roles (e.g., "oppressor" vs. "oppressed"). More frequently, the teacher relied on comparative language ("better than," "similar," "different") to talk about similarities and differences in historical and cultural contexts and events. Therefore, CATEGORIZE seems particularly useful in identifying and building mental models and frameworks, and drawing similarities and distinctions.

Our observation that DESCRIBE often co-occurs with references to teaching materials points to the mediatory role of materials in disciplinary learning. Teachers in our study frequently directed students' attention to visual aids, such as graphs and figures, to enhance comprehension, a practice highlighted by Morell (2020). For example, in math and science courses, descriptive language was used alongside materials like graphs to introduce processes and phenomena, such as the operation of a "shock generator."

The relatively infrequent use of DEFINE across all courses highlights a potential gap in explicitly teaching discipline-specific terminology. While this may reflect the assumption that students are already familiar with key terms, it also supports Breeze and Dafouz's (2017) argument that EMI programs often neglect the explicit integration of language and content learning. Incorporating more

deliberate focus on DEFINE could help address this gap, particularly in cases where students struggle with specialized vocabulary, as noted by Yıldız et al. (2017). For example, science teachers provided some definitions of terms like "inductive reasoning" and "diagnostic teaching," but these were not frequent, and often not signposted. Similarly, in Mathematics Education, the DEFINE function was used to articulate discipline-specific concepts such as "speed." More integration of such explicit instruction in defining discipline-specific terms could enhance students' ability to engage with complex concepts.

Our findings point to the interconnectedness between CDFs and disciplinary literacies, where specific CDFs align with various aspects of literacy development within disciplines. Nikula et al. (2024) emphasize that disciplinary literacies are inherently multi-semiotic and situated, and integrate specialized language, critical thinking, and multimodal resources. DESCRIBE and DEFINE, for instance, facilitate foundational knowledge-building by introducing key concepts and terminology, thereby enabling students to recognize and apply disciplinary vocabulary. REPORT connects new information with prior knowledge, and thus can help students contextualize and synthesize content. Higher-order functions such as EXPLAIN, EVALUATE, and EXPLORE involve reasoning, critical judgment, and inquiry-based thinking, which are essential components of disciplinary literacies. By organizing knowledge hierarchically, CATEGORIZE supports the development of conceptual frameworks. These examples indicate that different CDFs come into play when laying foundational knowledge, contextualizing content, fostering disciplinary reasoning and argumentation, analyzing and structuring knowledge, and encouraging hypothetical and critical thinking.

6. CONCLUSION

This study examined the use of CDFs in EMI courses in different teacher training programs within the faculty of education; therefore, the CDFs identified in the data reflect the characteristics of the language used by teachers in EMI courses in different fields. The analysis of EMI classroom discourse has shown that the distribution and realization of CDFs vary across disciplines and course topics, as a reflection of different cognitive and linguistic demands.

The findings demonstrate that while DESCRIBE was consistently prominent across all courses, the frequency of other functions tended to vary. For example, CATEGORIZE played a central role in computer education and educational technology courses; EXPLORE was more prominent in foreign language education; and EVALUATE appeared regularly in science education. In contrast, DEFINE was rarely used in any of the courses, which raises questions about whether

disciplinary concepts are assumed to be self-evident or whether definitional work is left to students.

The analysis also shows how specific CDFs support different dimensions of disciplinary literacy. For instance, DESCRIBE often tied classroom activity to course materials in an effort by the teacher to maintain students' attention on content. CATEGORIZE helped support the understanding of conceptual frameworks in technology-related courses. EXPLORE and EXPLAIN were essential when causal reasoning or speculative thinking was pedagogically relevant. EVALUATE served to engage students in logical inference and ethical considerations. Therefore, the pedagogical value of a CDF is not to be assessed only by its frequency but must be understood in relation to its disciplinary purpose and teaching context.

These findings indicate that a more deliberate integration of CDFs into EMI pedagogy could support students in developing disciplinary literacies. The prominence of DESCRIBE and REPORT reflects the role of teaching materials and prior knowledge as mediating resources. It is important, however, not to assume prior knowledge by all students, and to check for background knowledge before proceeding to introduce new content. Also, the low frequency of DEFINE points to the need for pedagogical design that place stronger emphasis on explicit teaching of discipline-specific terminology.

The study is not without limitations. The scope of data was restricted to a single faculty and a limited number of courses, which does not capture the wider range of disciplinary variation across EMI programs. Since the amount of teacher talk was substantial relative to student talk, the study only partially reflects how students themselves engage with/produce CDFs in classroom interaction. Extending the analysis to student contributions would provide richer insights into how learners engage with disciplinary discourse in EMI settings. Also, since the analysis depended on audio recordings, the use of multimodal/multisemiotic resources was not addressed, yet this reflects the conceptual orientation towards CDFs as verbalizations of knowledge.

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Badanie poznawczych funkcji dyskursu w rozwijaniu kompetencji dyscyplinarnych w akademickich programach EMI

ABSTRAKT. Niniejsze badanie dotyczy integracji poznawczych funkcji dyskursu (CDFs) w dydaktyce prowadzonej w języku angielskim (English-Medium Instruction, EMI) na różnych kierunkach studiów w Turcji, ze szczególnym uwzględnieniem programów kształcenia nauczycieli. CDFs posłużyły jako rama analityczna do zbadania, w jaki sposób język wspiera procesy poznawcze, takie jak opisywanie, wyjaśnianie, ocenianie i kategoryzowanie w kontekstach akademickich. Materiał badawczy obejmuje 472 minuty nagrań zajęć z pięciu kursów w trzech dziedzinach: edukacji informatycznej i technologii edukacyjnej, nauczania języka angielskiego oraz edukacji matematyczno-przyrodniczej. Analiza z zastosowaniem kodowania CDF umożliwiła identyfikację specyfiki poszczególnych dziedzin w zakresie użycia języka oraz sformułowanie implikacji dla rozwijania kompetencji dyskursywnych w ujęciu międzydziedzinowym. Wyniki ukazują związki między CDFs a rozwojem podstaw wiedzy oraz wspieraniem umiejętności wnioskowania i myślenia krytycznego. Sugerują także, że świadoma integracja CDFs w nauczaniu EMI może stanowić odpowiedź na wyzwania językowe i treściowe, z którymi mierzą się studenci. Artykuł wpisuje się w dynamicznie rozwijający się nurt badań nad EMI, dostarczając wglądu w relacje między językiem a konstruowaniem wiedzy w różnych dziedzinach akademickich.

Słowa kluczowe: poznawcze funkcje dyskursu, kompetencje dyskursywne w danej dziedzinie, szkolnictwo wyższe, kształcenie w języku angielskim.

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