Qualitative insights and a first evaluation tool for teaching with cognitive discourse function: "comparing" in the CLIL science classroom

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ABSTRACT: In CLIL research, Dalton-Puffer's recent construct of the Cognitive Discourse Function (CDF) (2013) - a taxonomy of seven cognitively and linguistically defined academic operations (such as "explain" or "define") - is now gaining increased attention as a useful tool to make the question of integration of language and content more tangible and operational.
However, little is known about these functions' specific nature, their teachability, their possible impact on students' L2 content learning and their assessment. This paper aims to address these questions by focusing on one CDF in the CLIL science context, the CDF of "comparing", a subtype of "classifying".
The objective of this article is twofold. First, it provides a developed account of the CDF of "comparing" based on previous research, illustrated by qualitative insights from a study in which secondary students learned science through an explicitly CDF-based teaching approach, using representative pre- and post-test examples. Second, building on this enhanced understanding of the CDF, it presents an evaluation tool for assessing students' CDF-based content performance.
The discussion compares this analysis with previous research and outlines the advantages of an explicit CDF-teaching approach to help students significantly display their subject contents in a more complete, precise, and explicit way.
Key words: CLIL, cognitive discourse function (CDF), "comparing", qualitative study, assessment.

Análisis cualitativo y propuesta de evaluación para una enseñanza con funciones cognitivas del discurso: "comparar" en el aula AICLE de ciencias

RESUMEN: En AICLE se está empezando a prestar atención al marco de las funciones cognitivas del discurso (FCD) (Dalton-Puffer, 2013), una taxonomía compuesta por siete operaciones académicas (como "explicar" o "definir"), que resulta útil para concretar la integración de contenidos y lenguas.
Sin embargo, poco se sabe sobre la naturaleza específica de estas funciones, cómo se pueden enseñar y evaluar y su impacto en el aprendizaje de contenidos. Este artículo se centra en una FCD ("comparar", un subtipo de "clasificar") en el aula AICLE de ciencias.
En primer lugar, se ofrece un análisis de esta FCD basado en investigaciones previas, que se ilustra con ejemplos cualitativos de un estudio en el que un grupo de alumnos de ciencias de Educación Secundaria recibió una enseñanza explícitamente basada en esta .

En segundo lugar, a partir de esta interpretación de la FCD "comparar", se ofrece una herramienta para evaluar cómo los alumnos presentaron sus contenidos de clase desde el enfoque de las FCD.
En la discusión se compara este análisis con investigaciones previas y se señalan las ventajas de una enseñanza explícita con FCD para que los estudiantes presenten los contenidos de clase de manera más completa, precisa y explícita.
Palabras clave: AICLE, funciones cognitivas del discurso (FCD), comparar, estudio cualitativo, evaluación.

1. Introduction

Content and Language Integrated Learning (CLIL) is now an integral part of the school curriculum across Europe, and many of the issues that characterised the initial stages of its implementation have now been resolved. However, there is also an acute awareness that the supposed integration of content and language learning does not always take place. One of CLIL's current concerns is therefore the question of integration on a conceptual and, in particular, a practical level (Morton, 2020). Research currently under way is clarifying the idea of integration by explaining the nature of and interrelation between CLIL's three learning dimensions - content, language, and cognition - and the disciplines that form its basis (educational sciences and linguistics) (Llinares, 2015; Llinares & Nashaat-Sobhy, 2021; Nikula et al., 2016).

However, the practical implementation of integration in the CLIL classroom still proves challenging, that is, we still lack sufficient information about how CLIL teachers can bring the idea of integration into their actual planning, teaching, and assessment (Oattes et al., 2018; Villabona & Cenoz, 2021). In Europe, various lines of research address this matter. These include an approach linking CEFR and subject descriptors by the Council of Europe (CoE) (Vollmer, 2011), a genre-based focus (Llinares & Nashaat-Sobhy, 2021), a subject-literacy approach, Pluriliteracy Teaching for Learning (PTL), introduced by the Graz Group (Meyer et al., 2015), and Dalton-Puffer's Cognitive Discourse Functions (CDF) (2013), the construct on which this article is focused.

Dalton-Puffer's construct of the Cognitive Discourse Function (CDF) (2013), illustrated in Figure 1, arose from an attempt to identify an overlap zone between the disciplines CLIL is based on (education and linguistics) that would provide CLIL teachers with a comprehensive tool through which they can foster their students' threefold - conceptual, cognitive, and linguistic - subject skills simultaneously. These functions lie at an interface zone between Bloom's (1956) and Anderson and Krathwohl's (2001) notion of thinking skills (cognitive sciences) and the concept of discourse function (applied linguistics), studied in particular by the ESP (Widdowson, 1979) and SFL tradition (Halliday & Matthiessen, 2004). Dalton-Puffer selected seven main cognitive discourse functions that seem to be essential for students' successful school learning. These are the CDFS of categorize, define, describe, evaluate, explain, explore, and report (see Figure 1).

The CDFS present an ideal tool to promote students' integrated subject learning, as each one entails a double, cognitively and linguistically demanding, learning process (Vollmer, 2010; Morton, 2020). For instance, when students are asked to perform the CDF of

explaining, they have to 1) work through a cognitively challenging process by establishing a cause-and-effect relationship and 2) verbalize it according to the CDF's specific discourse patterns (such as *is caused by*, *due to*, and similar linguistic expressions). Each CDF is tied to a specific set of lexico-grammatical forms and structures, which allows us to make their cognitive and verbal patterns visible (Dalton-Puffer, 2013), and thus teachable and learnable for CLIL users.

	TYPE	MEMBERS	COMMUNICATIVE INTENTION
1	CATEGORIZE	Categorize, classify, compare, contrast, exemplify, match, structure, subsume	I tell you how we can cut up the world according to certain ideas
2	DEFINE	Define, identify, characterize	I tell you about the extension of this object of specialist knowledge
3	DESCRIBE	Describe, label, identify, name, specify	I tell you details of what I can see (also metaphorically)
4	EVALUATE	Evaluate, argue, judge, take a stance, critique, comment, reflect, justify	I tell you what my position is vis a vis X
5	EXPLAIN	Explain, reason, express cause/effect, deduce, draw conclusions	I tell you about the cause or motives of X
6	EXPLORE	Explore, hypothesize, predict, speculate, guess, estimate, simulate	I tell you something that is potential (i.e., non-factual)
7	REPORT	Report, inform, summarize, recount, narrate, present, relate	I tell you something external to our immediate context on which I have a legitimate knowledge claim

Figure 1. Cognitive Discourse Function-construct (Dalton-Puffer, 2013)

Moreover, as Figure 1 shows, each CDF is also tied to a series of subforms referred to as "members", and to a "communicative intention", which is the purpose each function has to fulfil. "Comparing", for example, belongs to the group of "categorizing", which fulfils the analytical task of establishing categories after identifying patterns of similarity and difference.

Empirical research on CDFS has been conducted in particular through descriptive classroom studies, which observe the frequency, types, distribution, construction, linguistic adequacy, and metalanguage with which CLIL users (teachers and students) make use of these cognitive functions in their classroom practice across subjects, age levels, and languages (see Lose, 2007; Breeze & Dafouz, 2017; Lorenzo, 2017; Dalton-Puffer et al., 2018; Evntiskaya & Dalton-Puffer, 2020; Whittaker & McCabe, 2020; Doiz & Lasagabaster, 2021; Nashaat-Sobhy & Llinares, 2021). These findings show, however, that little of the expected intentional CDF learning actually seems to happen, as there is low incidence of CDFS in naturally occurring classroom discourse. In fact, many students have considerable difficulties when performing a CDF-task on their own, which suggests a lack of awareness and knowledge of these functions despite their role in fostering students' cognitive and literacy subject skills.

Consequently, research is now focusing on defining the different CDFS and their subforms, as in the case of "categorize" (Evnitskaya & Dalton-Puffer, 2020), "define" (Nashaat-Sobhy, 2020; Llinares & Nashaat-Sobhy, 2021; Bauer-Marschallinger, 2022), "evaluate" (Whittaker & McCabe, 2020; Hasenberger, ongoing), "explain" (Lose, 2007; Connolly, 2019) and "predict" (a subcategory of "explore" see Dalton-Puffer, 2007). There is also interest in determining how these functions can be taught, scaffolded, and assessed (Coetzee-Lachmann; 2019;

DeBoer & Leontjev, 2020; Del Pozo & Llinares, 2021; Bauer-Marschallinger, 2022; Lin & Wu, 2022; Hasenberger, ongoing). Researchers and content teachers are jointly validating teaching materials to promote CDFS in classroom practice (see LongAd-CLIL project by the UAM-CLIL research group). There are different attempts towards an integrated model for CLIL, linking the CDF-construct with different research traditions and other paradigms (Lemke, 1990; Rose & Martin, 2012; Maton, 2013).

Within this research scenario, this paper focuses on the CDF of "comparing", since it constitutes an inherent aspect of science education. I thus build on Evnitskaya and Dalton-Puffer's (2020). Dalton-Puffer's and Evnitskaya's (2020) conceptual map for the CDF of "classifying" by adapting it for the CDF of "comparing" and conducting a qualitative examination of the effect of explicit teaching on students' subject learning, offering a more complete and precise picture of its efficacy. This paper also seeks to present an initial framework for assessing students' CDF performance.

2. Importance of "comparing"

Making comparisons is a cognitive function that we have used instinctively since childhood to understand the world that surrounds us (Marzano, 2001). Comparison in the school classroom develops this natural, epistemic ability to introduce a scientific method of inquiry used across disciplines. To understand CDFS properly in CLIL, we should first examine what CLIL'S two founding disciplines (education and applied linguistics) say about this specific function, and what the natural sciences themselves say. In what follows, their visions of "comparing" are briefly presented.

In educational and cognitive sciences, various taxonomies include "comparing" as a cognitive thinking skill, classifying it as an upper-lower-order analytical operation together with "match", "classify", "generalise", and "specify", and situating it at the crossroads between "analysing" and "understanding" different conceptual matters (Bloom, 1956; Anderson & Krathwohl, 2001; Marzano, 2001; Biggs & Tang, 2011). "Comparing" thus occupies a key position between the lower- and higher-order skills. Studies on the educational value of comparison have established that learning to compare properly has positive effects on students' learning (Hammann & Stevens, 2003; Goldstone, 2010; MacArthur & Philippakos, 2010; Clark et al., 2020). For instance, it can help students to develop more:

1) organised and structured ways of learning, which tend to last longer;
2) abstract and relational thinking, as it implies looking for empirically, often non-deducible concepts;
3) detail-focused and better comprehensive learning;
4) flexible habits of mind, needed for thinking and applying ideas to new contexts;
5) advanced literacy skills.

Learning to compare seems to be an ideal starting point to introduce students to higher-order thinking skills. They can use this function later in combination with more advanced skills (such as "explaining" or "predicting").

In natural science, such as biology, making comparisons constitutes an inherent methodological tool (Martínez, 2018). Comparisons have been used since Aristotle to determine and catalogue the living world in a systematic way (Carpi & Egger, 2011; Flannery, 2010), and comparisons are often used in biology classes, as when the concept of mitosis is taught together with meiosis or RNA with DNA. Teaching students how to compare properly can help them understand better the logic and method of scientific disciplines.

In applied linguistics, the academic discourse function of "comparing" has been an object of study in several different areas. These include 1) English for Specific Purposes (ESP) and 2) Halliday's Systemic Functional Linguistics (SFL) (Halliday & Matthiessen, 2004), which considers these functions essential to develop students' academic language proficiency. Applied linguists define these functions are defined in terms of their concrete lexico-grammatical forms, which in the case of "comparing" would include "like", "unlike", "is similar", and "different from". The CDFS are thus associated with visible forms that can be taught, learned, and evaluated in the CLIL classroom. Research has helped clarify some of these analytical structures (see Cheong, 1978; Widdowson, 1979; Darian, 2003; Dixon, 2005; Huddleston, 2017).

3. Structure of "comparing"

Based on the literature from education and linguistics, the operation of "comparing" seems to be characterised by five components, which give rise to the following framework:

compare
- a) items being compared: *topic, target*
- b) comparative points: *criteria*
- c) types of comparisons: general, specific; similarity, difference, degree
- d) language *of* and *for* "comparing": *comparitor*
- e) parallel comparative structure.

These components will be briefly explained, as they constitute the framework used in the study to analyse and assess students' CDF production.

a. Items being compared: topic (x), target (y)

The first constitutive element of "comparing" addresses the question of what two items will be compared, that is, what is compared with what (Widdowson, 1979; Raphael & Kirschner, 1985; Marzano, 2001; Polias, 2015; Huddleston, 2017). The former item is referred to as "topic" (Cheong, 1978) or "comparee" (Dixon, 2005), while the latter as "target" or "standard".

At least two items need to be compared (x, y), and they must share a certain link since it makes no sense to compare two things with no relation (such as rabbits and doors). Moreover, the items can be of two types: 1) single, i.e., one item being compared at different moments of time or in different circumstances (for instance, on a day x and some days later), or 2) multiple, with at least two items, which can be compared in a part-part or part-whole relationship (such as an arm and a leg or the heart compared to the whole body).

b. Comparative points: criteria

Once the items (topic and target) are defined, the next step consists of establishing the underlying points on which these items can be compared, which have been referred to variously as "criterion" ("criteria" in plural) (Widdowson, 1979, Smith, 2019), "property", "parameter of comparison" (Dixon, 2005), "characteristic" (Marzano, 2001) or as the "basis" of a comparison (Widdowson, 1979). These points are usually abstract concepts (such as the physical, functioning or behaviour), and establish what aspects are relevant to the analysis.

When comparing different items (X-Y) on an underlying criterion (C), the following points should be considered (Darian, 2003):

1) Analyse the same criteria in both groups, for instance, physical appearance in X and Y. Otherwise, when the items differ (such as physical appearance in X and function in Y), the text stops being a comparison and becomes two separate descriptions.
2) Analyse the criteria in a balanced and complete way: give the same amount of information in one group (X) as in the other (Y), a phenomenon that has been referred to as "parallel connectivity" (Gentner & Markman, 1997), visualised in Figure 2.
3) Make the criteria explicit by naming them.

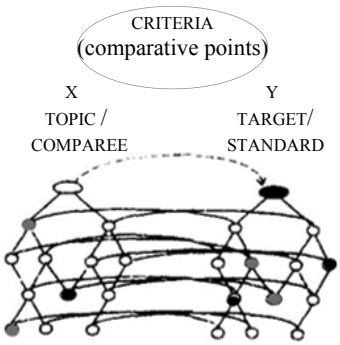

Figure 2. *Visualizing the idea of "parallel connectivity" (adapted from Gentner & Markman, 1997, p. 48)*

c. Types of comparison

The third element refers to the conceptual categories a comparison can adopt. There are two main types: 1) a general or specific comparison, and 2) a comparison in terms of similarities, differences and matters of degree.

Halliday and Hasan (1976) distinguished between general and specific comparisons, depending on the precision of the analysis. A general comparison presents something as similar, different, or identical in a general way without giving many details. In contrast, a specific comparison gives specific (quantitative and qualitative) information on how the items are like or unlike.

The second type classifies a comparison based on the relationships of similarity, difference, equality, inequality and matters of degree, among which the relationships of similarity and difference, also referred to as "likeness" and "unlikeness" (Halliday & Matthiessen, 2014) or "positive" and "negative" one (Cheong, 1978; Darian, 2003), are considered as the basis. However, regarding the other forms of relationship (equality, inequality, and degree), linguists differ in classifying these relational forms. Some group them together with the main ones (similarities and differences) (Polias, 2015), while others include them in a third (Halliday, 1976; Widdowson, 1979) or even a fourth group (Darian, 2003), as is the case with Cheong (1978), who differentiates between 1) equality, 2) inequality, 3) similarities and differences, and 4) what he calls "relation of oppositions", which includes forms such as "whereas" or "in contrast".

d. Language of "comparing": comparitor

The fourth element concerns the language *of* and *for* comparison, which are the specific lexico-grammatical forms and structures through which one of the previously presented comparative relationships (similarity, difference, degree) can be expressed and thus made explicit for others, something considered as "stated" comparisons.

There are three main types of comparative linguistic forms: 1) forms of contrast (such as "different", "dissimilar" or "whereas"), 2) forms of comparison (like "similar to", "both") and 3) grammatical forms (composed of "less/more" + adj. -suffix-"er" + "than"). The umbrella term for these forms is called *comparitor* (Darian, 2003), and the subordinated forms are *resemblers*, *differentiators*, and *comparatives*. Significant research was done, particularly in the areas of ESP and SFL, to clarify the concrete nature of these forms (see Widdowson, 1979; Halliday & Matthiessen, 2004; Evnitskaya & Dalton-Puffer, 2020).

There are other less explicit linguistic means to indicate a comparative relationship, by using, for instance, prosodic stress on two related word groups (such as "one …another…" or "one kind…a different kind…") or by arranging them in a syntactically parallel way, as the following example shows: "Bats are mammals. Pigeons are birds", which makes the reader infer that these animals do not belong to the same group without explicitly saying so.

e. Parallel comparative structure

Finally, a comparison is also characterized by its parallel structure, according to which different items can be compared and contrasted in a systematic way. There are two main ways of doing this:

1) the block method (Smith, 2019), also known as *subject-by-subject* (Smith, 2019), *whole-whole* (Raphael & Kirschner, 1985) or *bipolar method* (Gray & Keech, 1980).
2) the point-by-point method, with alternative names such as *alternating* (Smith, 2019), *part-part* (Raphael & Kirschner, 1985) or *integrated method* (Gray & Keech, 1980).

The block method, consists of analysing first all the points (criteria) in one group and then in the other; that is, it proceeds by blocks, while the point-by-point method favours an alternating, interrelated procedure, where the different points (criteria) are analysed in

both groups simultaneously. To help students use these frameworks, graphic organisers can be useful (such as Venn diagrams, top hat organisers, Y-organisers, or a side-by-side table) (Silver, 2007).

In summary, to make students use and learn through the CDF of "comparing", they will need to know:

1) how to introduce the to-compare items (*topic*, *target*),
2) base their analysis of differences and similarities on some shared and relevant points (*criteria*), which tend to become more specific as students move through their years of schooling,
3) present the comparative relationships in an explicit and systematic way by using CDF-related lexico-grammatical forms (*comparitors*) and by arranging the points in a parallel way (*block* or *point-by-point structure*).

Moreover, students will need to develop a certain discipline-specific understanding of why and how to use CDFS (such as "comparing") in a concrete subject, as it is not the same to "compare" in science or history.

4. Qualitative insights

4.1. Study context and design

An exploratory study was conducted with 37 seventh-grade students (aged 12-13) which learned to process their science (biology) contents through an explicit CDF-based (comparison-based) teaching approach. The study took place in a middle-class, charter-like school in the north of Spain (Navarra), which had a long teaching tradition in bilingual education (social and physical sciences taught 50% in English, natural sciences 30%). The students' L1 was Spanish, except three bilingual students (2 Spanish/Chinese, 1 Spanish/Polish), with English as L2, being evaluated at a low B1 level (CEFR) by their CLIL biology and EFL teacher.

To trigger students' CDF use, they were asked to hand in three written comparisons on the topic of biodiversity to their CLIL biology teacher, one before and two after the intervention. CDF instruction consisted of two sessions, where the comparison components were explicitly taught and practised through explanatory slides, forming comparative statements, deconstructing comparative texts and redoing their first comparisons.

For validity, content experts and linguists examined these resources in terms of clarity, content authenticity, curricular demands and level of difficulties adjusting it to the students' competences. Besides, these tools were previously tested with same-age students in a natural science CLIL classroom in a nearby school.

The study took a stepwise, content-supportive and collaborative approach by first activating the receptive and then the productive skills, as recommended by Cummins's four quadrants (2008), the learning-cycle idea from the genre tradition (Rose & Martin, 2012) and recent CDF-research (Nashaat-Sobhy, 2020; Bauer-Marschallinger, 2022). The idea was to not overload the students, and to avoid turning the content class into a language one, rather making them see "comparing" as part of their science education.

In order to facilitate comparison, the three tasks followed a similar design, as can be seen in Table 1, always requiring a comparison between two animal groups.

Table 1. *Study design*

COMPARATIVE TASKS	PURPOSE
1. *compare herbivores and carnivores.*	pre-test explicit instruction
2. *compare vertebrates and invertebrates.*	1. post-test
3. *compare reptiles and mammals.*	2. post-test

Some representative pre-and post-tests will now be shown to illustrate students' learning process in each of the five points of the framework. Based on the previous literature review, this includes, whether the students were able to a) introduce the to-compare items (topic and target), b) base their comparisons on shared points and mention them explicitly in a topic sentence relying on nominalisations or abstract nouns, c) generate specific and justified comparisons which include the three comparative relationships (differences, similarities and degrees), d) use lexico-grammatical forms to express a comparative relationship and e) organise the contents in a parallel way (point-by-point or block-method).

Qualitative analysis will be used to obtain a more precise picture of how the students work with CLIL class contents through comparisons.

4.2. Qualitative insights

a. Items being compared: topic and target

Regarding the first point, the selection of the items to be compared (topic and target), most students understood that "comparing" consists of contrasting at least two entities, in this case, two groups of animals. However, it was not until the post-test that they started to introduce these groups with an introduction or to contextualise them by classifying them into their corresponding biological groups or taxonomies.

The following pre- and post-test extracts (see Figure 3, examples 1 and 2) illustrate how most students initially simply placed the topic (carnivores) in contrast to the target (herbivores). In contrast, in the post-tests, the students learned to introduce both groups (saying they will compare two groups of vertebrates (reptiles and mammals), sometimes even classifying them into biological categories (being vertebrates and not invertebrates).

PRE-TEST	POST-TEST
(1) Carnivores (topic) have incisors, canines, premolars, and molars that used to eat. Herbivores (target) have at the beginning they do not have teeth. They have large chewing molars and premolars. (10AM)	(2) **I'm going to compare two groups of vertebrates**. As you know **animals can be classified into two groups: vertebrates and invertebrates. Inside vertebrates** they are five groups: fish, amphibians, reptiles, mammals, and birds. But **I' am going to compare** between **reptiles** (topic) **and mammals** (target). (10AM)
no introduction or contextualisation	introduction and contextualisation (classification)

Figure 3. Pre- and post-test example: working with topic and target

b. Comparative points: criteria

Regarding criteria, students' pre- and post-test writings were analysed in terms of whether students used the same comparative points for both groups, if they mentioned them explicitly and if they subordinated similar features under common concepts.

In the pre-tests, most students already showed initial awareness of the criteria, as they based their analysis on some shared, albeit implicit, comparative points. Few students failed to provide a valid comparative statement as they analysed different criteria among the groups, presenting descriptions instead. This is the case in Figure 4 example 3, where the common criterion is unclear: the student refers to different ideas in each group (such as the chewing time needed to digest certain types of food or the dimension of the skull). Besides, he/she presents the information in a fragmented, uncoordinated way, reflecting his/her flow of thoughts. This way of proceeding led many students to present the contents in an incomplete way, filled with logical jumps, informative omissions, and repetitions.

By contrast, after the CDF instruction, the students generally introduced and mentioned the comparative points (criteria) more explicitly in a topic sentence using nominalisations, as in Figure 4 example 4. The student explains how reptiles and mammals differ in terms of being cold- or warm-blooded, and he/she relates this to other issues, such as temperature, environmental adaptation, and diet, which shows more comprehensive, relational content understanding. A few preferred simply to paraphrase the main idea: "Another thing is how their live" instead of using the term "habitat". However, the exercise of focusing on main ideas and subordinating the rest under them helped most students introduce a certain order into their writings and relate their initially loose content points better.

PRE-TEST	POST-TEST
(3) The **herbivores** and **carnivores** have different that the **herbivores** need to chew a lot, instead of the **carnivores**, the meat is easier to digest. The skull of the **carnivore** is biggest than the **herbivore** one, the **herbivores** need to eat a lot to of energy but meat has a lot of energy and herbivores ' jaw has a gap. (9CM) (unclear common criterion)	(4) First thing is the blood type (clear criterion). Well obviously, both of them have it. On one hand **reptiles** are ectothermic animals, so they have cold blood. It means that: Their body temperature depends on the environment, if the environment is cold their bodies too (…). They normally live in warm places and they require less food/energy. On the other hand, **mammals** are endothermic (warm-blooded) that means that they can regulate heat by themselves so they can live in any environment. And they need more food to keep their bodies warm. (9CM)

Figure 4. Pre- and post-test example: building comparative concepts (criteria)

c. Types of comparison

As for the different types a comparison can take, the students' pre- and post-tests were examined according to Halliday's and Hasan's (1976) general and specific comparisons, and the three comparative relationships (difference, similarity, and degree).

Most students' pre-tests can be classified as general or incomplete comparisons, because they sometimes simply indicated that something was different or similar without specifying or justifying their answers, or they only did so for one of for the two groups. Figure 5 example 5 visualises this: the student simply indicates that carnivores and herbivores differ in their way of chewing and are similar in having a skull, but at no time does he/she develop these points in more detail. Besides, the information provided is rather superficial. Omission occurs where the student describes the carnivores' teeth but omits the corresponding information for herbivores, resorting to a commonly used affirmation-negation (*have-don't have*) pattern, giving rise to an incomplete or "unbalanced" content presentation.

In contrast, most post-tests provide more specific comparisons, as the students tried harder to integrate both differences and similarities and presented these points in a more balanced way, giving the same amount of information for both groups. Moreover, as can be seen in Figure 5 example 6, the information is more task-focused and justified. To achieve this, the students relied on a wide range of linguistic resources, such as relative clauses, explanatory, exemplifying and consecutive forms, as well as action verbs, similes, and definitions.

PRE-TEST	POST-TEST
(5) **Common:** (similarities) - They **both** need to eat their nutrients. - They have skull **both** of them. **Different:** (differences) They have different ways to chew the food. -The teeth have different positions. - Carnivores have great canines to eat easier the meat, herbivores not because they don't need so. (9AF) general comparison unbalanced (incomplete) content presentation	(6) I'm going to talk about the physical of **both** groups. **Both** have a skin (similarity), reptiles' skin is covered by scales, **while** mammals' skin is covered by fur/hair **that is beneficial for heating** themselves (…) (difference). **Both** kinds of animals are tetrapodal (similarity), **that means that** they have four legs, **but** not always. Some mammals **like** dolphins have flippers and some reptiles **like** snakes have not any legs, **so** they are legless (difference). (9AF) specific comparison balanced (complete) content presentation

Figure 5. Pre- and post-test example: using comparison types

d. Language of and for "comparing": comparitor

When examining the students' use of lexico-grammatical forms to express a comparative relationship, the so-called comparitor (Darian, 2003), special attention was paid to the number, types, and formal and functional adequacy, that is, whether the students learned to use these forms without making any grammatical or lexical mistakes, and if they correctly fulfilled the communicative intention.

In the pre-test, as shown in Figure 6 example 7, most students used hardly any comparitors, forming linguistically implicit comparisons. Only basic forms appeared, such as *is*

different or *but*. Nevertheless, the students relied on alternative forms to create contrasts, such as: 1) antonyms (like *difficult-easy*), and 2) an affirmation-negation pattern (*have - don't have*).

By contrast, in the post-test, the students substituted most of these alternative syntactic forms with comparitors, offering more explicit comparisons. They included a greater number of forms, and used more advanced constructions (such as *on the one hand…on the other*, *whereas* or *while*), also combining them as in post-test example 8 (Figure 6).

From a formal perspective, lexico-grammatical mistakes in comparitors were frequent in both pre-and post-tests ("-er" or "than" forms were missing or literally translated from Spanish), which suggests either poor grammatical, lexical, and orthographic knowledge or perhaps lack of attention while performing the task. However, from a functional perspective, the students clearly did evolve. Most seem to have understood their importance for signalling comparative relationships, as they used forms for contrast and similarity appropriately.

PRE-TEST	POST-TEST
(7) Herbivores eat plants and carnivores eat meat. Herbivores need to be eating all day, **but** (contrast form) carnivores just need to eat one time. Herbivores digestion is very *difficult* and carnivores digestion is *easy*. (6CF)	(8) Vertebrates and invertebrates are **different** (contrast form) in the size and the movement too. **On the one hand** (contrast form), vertebrates are **bigger** and **faster** (gram. comparative form). **On the other hand**, invertebrates are **small** and **slow**. They are also **different** (contrast form) in the body organs. Vertebrates have **more advanced** (gram. comparative form) organs and they have a *closed* circulatory system, **whereas** (contrast form) invertebrates have **simpler** body organs and an *open* circulatory system. (6CF)

Figure 6. Pre- and post-test example: using comparative language (comparitor)

e. Parallel comparative structure

Last, we present an insight into students' use of one of the two comparative methods discussed before (point-by-point and block-method).

In the pre-tests, the students showed a tendency to organise the contents in a parallel way, since they presented a point first in one and then in the other group, progressing successively, as the point-by-point method prescribes. This method is basic, but also rigid: when not combined with other structural devices it creates the effect of a ping pong match, with ideas passed mechanically from one side to the other without any possible clarifications. Only a few students included alternative structural elements, such as discourse markers, or juxtaposed similar word groups to make their texts more reader friendly.

On the other hand, after the CDF intervention, the students endowed their texts with a clearer internal structure: they combined the point-by-point method with some basic structural genre features, which include using an introduction, conclusion, paragraphs, topic sentences and linking devices. They used additive forms (*also, furthermore, moreover*), contrastive ones (*although, nevertheless, however*), causal (*due to, because, the reason is, so*), exemplifying (*for example, such as*) and sequential ones (*first, second, another, finally*).

The following pre- and post-tests (see Figure 7 examples 9 and 10) illustrate how most progressed from a relatively rigid and monotonous writing style to a more dynamic, reader-aware one.

PRE-TEST	POST-TEST
(9) The herbivores eat plants and the carnivores eat meat, **also** (additive form) the herbivores don't have canines and the carnivores have great canines. Herbivores have broad incisors and the carnivores have pointed incisors. The herbivores take a lot of time to digest and the carnivores do it quickly. (8AM)	(10) **First** (sequential form) I'm going to compare the two types of animals skeleton. The vertebrates have an endoskeleton, **which** (relative clause) is an internal skeleton, while the invertebrates have an exoskeleton, **which** develops outside the body. The endoskeleton is **like** (exemplifying form) the internal framework of a house, **so** (causal form) it supports us and it allows us to move. (8AM)
no paragraph organization; few linking devices	paragraph organization; some linking devices

Figure 7. Pre- and post-test example: using comparative structure

5. Evaluation tool for the CDF of "comparing"

When we contrast students' pre-and post-tests, we can see that their comparisons improved in completeness, precision (task-relevance and justification) and explicitness. These three criteria of quality allow us to classify and evaluate the students' written comparisons into three levels of proficiency: a low, medium, and an advanced level. Figure 8 presents some examples for each of these levels.

The first level is the most basic. The writer fulfils the minimum requirements of the comparison, presenting at least some similarities and/or differences between the items being compared based on some shared criteria, regardless of whether they are explicitly mentioned or not. The pre-test examples reflect this level, since the students presented similarities and differences vaguely, without justifications, and the comparative statements were often incomplete ("unbalanced") and implicit, with few comparitors and no explicit mention of comparative points (criteria).

The second level represents a medium stage, which requires students to replace their general and partial comparisons by more specific, complete ones. We are not only told that something is similar or different, but also given further explanations and justifications. Students also signal the comparative relationships more by using a greater number of comparitors and introducing more comparative criteria, using nominalisations and abstract nouns.

The third level is reached when students present the content points (differences and similarities) in a complete, specific, justified, and explicit way. That includes, presenting the contents in paragraphs, with the main comparative idea (criteria) in the topic sentence, followed by a balanced, linguistically explicit and reasoned presentation of differences and similarities between groups.

	1. LOW LEVEL	2. MEDIUM LEVEL	3. ADVANCED LEVEL
QUALITY CRITERIA	**1. *COMPLETNESS***: some differences and/or similarities; incomplete (unbalanced) content presentation.	some differences + similarities; more complete (balanced) content presentation.	several differences + similarities; complete (balanced) content presentation.
	2. *PRECISION (specific, relevant, justified):* general, not task focused, unjustified information.	more specific, relevant, justified information.	specific, relevant, justified information.
	3. *EXPLICITNESS:* implicit criteria; few comparitors; mixed parallel structures.	some explicit criteria; basic comparitors; point-by-point method.	explicit nominalized criteria in topic sentence; advanced + combined use of comparitors; point-by point method + general structural devices.
EXAMPLES	General detection of difference/ similarity: (Herbivores and carnivores) have different ways to chew the food. Common: they have a skull. (9AF) Unbalanced (incomplete) content: Herbivores have not canines, but carnivores have**.** (12AM) Vague information (similarity): The herbivores and carnivore animals have in common that they all have teeth and they use it to masticate the food. (7AF)	Balanced, specific information; explicit comparative points + use of comparitors: (Vertebrates and invertebrates) are different in the body organs**.** Vertebrates have more advanced organs and they have a closed circulatory system, whereas invertebrates have simpler body organs and an open circulatory system. (6CF) Relevant similarity: The first thing they have in common (reptiles and mammals) is that both have a backbone; so they are vertebrates. (8AM)	First thing is the blood type. Well obviously, both of them have it. On one hand reptiles are ectothermic animals, so they have cold blood**.** It means that: Their body temperature depends on the environment, if the environment is cold their bodies too (…). On the other hand, mammals are endothermic (warm-blooded) that means that they can regulate heat by themselves so they can live in any environment. (9CM)

Figure 8. Classifying students' comparisons into 3 proficiency levels

6. DISCUSSION

This study has provided a comprehensive analysis of the CDF of "comparing" and applied it to the CLIL science classroom. The results show that an explicit and guided CDF-teaching approach can help students improve in all five points that define a good scientific comparison, moving from a basic impressionistic approach towards a proficient content presentation.

The pre-tests confirm what previous acquisition-driven classroom studies report about students' natural CDF-use (see Breeze & Dafouz, 2017; Lorenzo, 2017; Dalton-Puffer et al., 2018; Evnitskaya & Dalton-Puffer, 2020; Whittaker & McCabe, 2020; Llinares & Nashaat-Sobhy , 2021), in that when students are left on their own, without guidance or support, they have difficulties developing complete CDFS, presenting instead more implicit, basic, and fragmented ones. This seems to be linked to weak conceptual and procedural CDF-knowledge.

When looking at students' content display, initially they hardly included any points of similarity, and when they did, the information provided was often irrelevant, superficial, and not linked to the subjects' purpose. In biology, similarities can be used, for example, as a criterion to establish and justify class memberships. However, the students only associated "comparing" with presenting differences, as Evnitskaya and Dalton-Puffer (2020) noted when studying the CDF "categorize". In addition, the content points (*differences and similarities*)

were often not equally specified and justified, giving raise to general, unbalanced comparisons, which coincides with Coetzee-Lachmann's (2009) and Bauer-Marschallinger's (2019) classroom observations, where students struggled to present content accurately and completely.

Another weak point was students' preference to work with concrete elements, instead of grouping the single class contents under superordinate ideas, using comparative concepts (*criteria*) and introducing them explicitly in a topic sentence. Some experts have linked this difficulty to low levels of abstraction (see Marzano, 2001; Lorenzo, 2017; Evnitskaya & Dalton-Puffer, 2020; Nashaat-Sobhy, 2020; Whittaker & McCabe, 2020).

As for students' language performance, this resembles former studies (Bauer-Marschallinger, 2019; Evnitskaya & Dalton-Puffer, 2020), in that students used basic lexico-grammatical comparative forms (*comparitors*) at first. This made it hard to see whether the students had processed and understood the class contents well since they did not point to their underlying comparative relationship (Breeze & Dafouz, 2017; Bauer-Marschallinger, 2019). To overcome this, however, as in Evnitskaya's and Dalton-Puffer's study (2020), the students relied on alternative forms (juxtapositions, affirmation-negation patterns) to present contrasts, which shows that to indicate a comparative relationship comparitors are not an indispensable requirement for a valid comparison (Breeze & Dafouz, 2017; Bauer-Marschallinger, 2019), although not using them makes their texts lose fluency and clarity.

When examining students' organizational skills, the pre-tests coincide with previous studies (Lorenzo, 2017; Bauer-Marschallinger, 2019; Evnitskaya & Dalton-Puffer, 2020) in that the points were listed without being introduced, linked, or worked with in depth. Besides, the texts presented some logical jumps and fragmented, unfinished sentences, which is probably due to a lack of prior planning or attention. However, they already followed a basic point-by-point pattern.

In general, students moved from an initial, albeit weak CDF knowledge, where they associated "comparing" with presenting differences, based them on some shared concepts, used juxtaposed expressions, some primary linguistic comparative forms and followed a first point-by-point structure, towards a more complete, explicit, and cognitively advanced subject presentation.

On the other hand, the post-test results can be compared with recent interventional studies, which focus on implicitly and explicitly teaching CDFs in secondary and tertiary CLIL level (see Breeze & Gerns, 2019; Connolly, 2019; Nashaat-Sobhy, 2020; Bauer-Marschallinger, 2022; Hasenberger, ongoing). This study, however, differs slightly from these in that here the CDF of "comparing" is defined through the literature and dialogue with experts, and efforts were made to teach "comparing" according to its conceptual, linguistic and functional specifications.

The present results confirm previous studies suggesting that explicitly teaching CDFs can enhance students' subject expertise. The students raised their number of lexico-grammatical CDF forms, used a greater variety and combined these forms, in particular with definitions and explanations, which shows a richer linguistic command and verifies the interconnected and constructive nature of CDF (Dalton-Puffer, 2013). In addition, the students developed a certain meta-linguistic awareness about why to use comparisons (CDFs) in their content class (biology), which moves beyond applying a set of contrastive and comparative forms. As Breeze and Gerns (2019) stated, this makes them become more conscious about their own learning process and the way they construct and share their knowledge in class. Accordingly,

they try harder, including more content points (*differences and similarities*), subordinating and introducing them under comparative concepts, developing them with more precision and using a greater variety of linguistic and structural devices (i.e., *comparitors, linking words, introduction, conclusion, and paragraphs*).

Previous studies (Breeze & Gerns, 2019; Nashaat-Sobhy, 2020; Bauer-Marschallinger, 2022) mentioned the positive impact that teaching CDF-features or even general academic writing can have on students' content and organisational performance. This study confirms that when the students learned to use comparitors, they began to focus more on including differences and similarities. Similarly, when they learned to build comparative concepts, they structured their content points better, differentiating between primary and secondary ideas and ordering them by paragraphs. In other words, the study observed a reciprocal effect when teaching one academic feature (whether conceptual, linguistic, or structural) on the others.

Of course, students still had some difficulties in presenting similarities in a subject-purposeful way, or in building comparative concepts by using nominalisations, as they sometimes simply paraphrased the main idea. Some also overused comparitors, which gave the impression that they simply wanted to meet the task requirements. This shows that a CDF approach needs more time and practice.

Last, when assessing students' CDF performance, we can see that learning to compare requires a stepwise, scaffolded learning process (Nashaat-Sobhy, 2020; Bauer-Maschallinger, 2022), which does not move automatically from low towards proficient levels. The three criteria presented (completeness, precision, and explicitness) characterise good CDF performance and should thus be included when explicitly teaching CDFs. Moreover, they offer us a tool to evaluate students' subject performance in an integrated way considering the related conceptual, linguistic and structural features.

7. Conclusion

The CDF-construct proves to be an easy-to-work with and practical tool to introduce scientific writing and help students participate in the disciplinary discourse in which subject contents are processed, constructed and communicated.

The five-point framework for "comparing" (taught during the instruction classes) enabled students to understand the importance "comparing" has in and for their science education and to raise their awareness on the subject-specific language and cognitive demands required to fulfil this task, which helped them move beyond a surface and experiential-driven understanding to a deeper level of engagement with the content (Evnitskaya & Dalton-Puffer, 2020).

This article offers an example of how the CDF of "comparing" can be operationalised and assessed in a CLIL science classroom, illustrated by qualitative insights from secondary students' written performance. However, to convert the CDFs into a solid pedagogical tool for the CLIL classroom, further research is required to operationalise the remaining CDFs, to understand how its three-fold nature works in different learning contexts and to provide guidelines for its use across the different disciplines and age levels.

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