The Effects of Instruction on Students' Argumentative Scientific Writing in a Basque Medium of Instruction Setting

Eneritz Garro Larrañaga[1], Eneko Antón[1/2], Roberto Arias-Hermoso[1], and Unai Carmona[1]

[1] Faculty of Humanities and Education Sciences, Mondragon Unibertsitatea

[2] Centro de Investigación Nebrija en Cognición, Universidad Antonio de Nebrija

Garro Larrañaga, E., Antón, E., Arias-Hermoso, R., & Carmona, U. (2024). The Effects of Instruction on Students' Argumentative Scientific Writing in a Basque Medium of Instruction Setting. Journal of Immersion and Content-Based Language Education. Online advance publication. https://doi.org/10.1075/jicb.23014.gar

Authors version

Author note

Eneritz Garro Larrañaga https://orcid.org/0000-0002-6148-8383

Eneko Antón https://orcid.org/0000-0003-1971-978X

Roberto Arias-Hermoso https://orcid.org/0000-0002-0780-7320

Unai Carmona https://orcid.org/0000-0001-9745-7370

We have no interest of conflict to disclose.

This work was supported by the Spanish Ministry of Science, Innovation and Universities [grant number PID2019-111655RA-I00; PID2021-126884NB-I00] and by the Basque Government [grant number IT1664-22 & PRE_2021_1_0001].

Correspondence concerning this article should be addressed to Eneritz Garro Larrañaga, Faculty of Humanities and Education Sciences, Mondragon Unibertsitatea, Spain. Email: egarro@mondragon.edu

The effects of instruction on students' argumentative scientific writing in a Basque medium of instruction setting

Abstract

The present quasi-experimental study explores the effects of instruction on secondary students' scientific argumentative writing in a Basque medium of instruction program. Secondary students (*N* = 105) completed written tasks before and after a unit on energy in their science class as part of this investigation. The experimental group (*n* = 61) additionally took part in three, one-hour sessions focused on scientific argumentation via instruction in cognitive discourse functions (Dalton-Puffer, 2013), while the control group (*n* = 44) completed the unit on energy without the additional instruction on argumentation. The final corpus of 210 texts was analysed using Toulmin's Argumentation Pattern (1958). ANOVAs showed that the experimental group's use of argumentation strategies increased significantly, while the control group's use of such strategies did not increase. Thus, the results show that instruction on argumentation helps students to write better argumentative compositions. These findings suggest that instruction in the use of Cognitive Discourse Functions allows for academic language learning in bilingual education contexts. The pedagogical implications and future research directions of this study's findings are discussed.

KEYWORDS

Argumentation, cognitive discourse functions, scientific writing, Secondary Education, Basque.

Authors' version

Introduction

All languages used in school settings can be referred to as languages of schooling (Beacco et al., 2016) and include the learners' entire linguistic repertoire, entailing languages of instruction and home languages. Students' development of this repertoire is key to ensuring their academic and social success (Beacco et al., 2016; Lorenzo & Trujillo, 2017; Pavón & Pérez, 2017). Today, many education systems foresee students mastering more than one language (Council of

Europe, 2017), and diverse strategic pedagogical approaches have been implemented to achieve this in programs labelled as content-based instruction (CBI), immersion, content and language integrated learning (CLIL), and bilingual education, in which the language of instruction for many students is not their first or dominant language (L1). Learning through a non-dominant language, be that a second (L2) or foreign language (FL), poses certain challenges for learners in achieving biliteracy (Lorenzo & Rodríguez, 2014).

In the Basque Autonomous Community (BAC) curriculum, educational programs are required to consider the two official languages (Basque and Spanish) in order to develop students' multilingual competence. To achieve this, the BAC established three main language models (Cenoz, 2023; Colmenero & Lasagabaster, 2023). These differ in their amount of exposure to both Basque, the minority language, and Spanish, the majority language: Model A (instruction entirely in Spanish with Basque as a subject), Model B (partial exposure to both Spanish and Basque) and Model D (instruction entirely in Basque, with Spanish as a subject). While Basque is not the dominant language of the majority of students, 71.9% of secondary education learners (EUSTAT, 2023) are enrolled in Model D. As suggested by several authors (Aldekoa et al., 2020; Cenoz, 2015; Lasagabaster & Sierra, 2010; Manterola et al., 2012; Sagasta, 2003) the Model D is a Basque medium of instruction program that can be considered a CBI or an immersion programme for non-Basque L1 speakers, and as a bilingual language maintenance programme for those whose L1 is Basque.

Previous research has traditionally distinguished between CLIL, CBI, immersion and bilingual education programmes by highlighting similarities and differences in their nature, history and characteristics (see Dalton-Puffer et al., 2014; Lasagabaster & Sierra, 2010; Llinares & McCabe, 2023). Despite these terminological and methodological differences, which are not the focus of this study, all share *integration* as their "essential property" (Cenoz, 2015, p. 17). Nevertheless, this integration of content and language is complex and both content and language have to be considered in developing objectives, instruction, and assessment (Nikula et al., 2016; Tang, 2019). Coyle and Meyer (2021) suggest that the integration of content and language may

Authors' version

lead students to successfully develop the academic language of various disciplines and languages, and thus become *pluriliterate*. However, academic language needs to be explicitly addressed in education (Cummins, 1984, 2021), and this is normally carried out in subject-specific ways—in other words, though disciplinary literacies (Shanahan & Shanahan, 2008). This is important because the linguistic features of school subjects differ across disciplines (Beacco et al., 2016; Coyle & Meyer, 2021; Llinares et al., 2012). It is therefore crucial to describe the main academic language features and patterns associated with disciplines and disciplinary literacies (Lorenzo & Trujillo, 2017).

One of those academic language patterns is the focus of this quasi-experimental study, as we explore the production of arguments in scientific argumentative writing in a Basque medium of instruction Secondary Education programme, guided by the construct of Cognitive Discourse Functions (CDFs; Dalton-Puffer, 2013).

Authors' version

Literature Review

Cognitive Discourse Functions: The Case of Argue

The CDF (Dalton-Puffer, 2013) construct has been suggested as powerful tool that teachers can leverage as they seek to integrate language, content and literacies in their instruction (Morton, 2020). CDFs represent discourse patterns that have crystallised in response to specific situational and contextual demands (Dalton-Puffer, 2007, 2013). According to Bailey and Butler (2003), the main focus of the CDF construct is the realisation of operative verbs such as *defining*, *comparing* or *arguing* (see Table 1) to "name concrete linguistic behaviours by which students are expected to demonstrate their content knowledge" (Dalton-Puffer 2013, p. 223). The CDF construct is composed of the most common operative verbs within academic contexts, which are then divided into seven main categories: *categorise, define, describe, evaluate, explore, explain,* and *report.* Each category is broad and may contain different subforms or performative verbs that share the same underlying communicative intention (see Table 1). They represent cultural models shared by discipline-related communities and have specific discursive schemata and lexicogrammar (Dalton-Puffer, 2013). In fact, CDFs need to be contextualised within disciplines, as what is understood by *argue* may be different in science or history. For example, scientific argumentation is characterised by the use of scientific and experimental evidence (Polias, 2016), while arguing in history focuses on taking a stance towards historical events (Lorenzo, 2017).

Table 1

The Cognitive Discourse Function Construct

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

Note. Adapted from "Cognitive discourse functions meet historical competences: Towards an integrated pedagogy in CLIL history education" by C., Dalton-Puffer and S., Bauer-Marschallinger, 2019, *Journal of Immersion and Content-Based Language Education, 7*(1), p. 35 (https://doi.org/10.1075/jicb.17017.dal). The boldface on EVALUATE is ours.

Authors' version

Among these seven CDFs, knowing how to make use of *evaluate*, and its subform *argue*, have been described as crucial knowledge for successful participation in 21st-century democratic societies (Asterhan & Schwarz, 2016) and are therefore critical for academic success. Dalton-Puffer (2016, p. 42) describes how evaluation requires expressing "evidence, criteria, standards or reasons which support [...] taking a stance, justifying decisions and arguing one's opinions." Whittaker and McCabe (2023) point out that students need to master discipline-specific forms of evaluation, including justifying their opinions using content-related knowledge. However, to date, *argue* has not been conceptually operationalised as a CDF, which would appear to be necessary for the purposes of education and research (Gerns, 2023b; Lorenzo & Trujillo, 2017).

Argumentative Writing in Science

Arguing involves using reason and logic to defend the truth of the writer's or speaker's position or claim (Sandoval & Millwood, 2007). Argumentation plays an important role in science education (Jiménez-Aleixandre & Erduran, 2007; Martín-Gámez & Erduran, 2018) and uses specific methods of justification based on research evidence and scientific knowledge (Whittaker & McCabe, 2023; Polias, 2016). Following a systematic review of various experimental studies on scientific argumentation instruction, Li et al. (2022) conclude that teaching scientific argumentation benefits students' understanding of scientific concepts when compared to traditional instructional approaches. Nevertheless, arguing is often regarded as an intellectually and linguistically challenging skill (Ferretti & Fan, 2016; Meneses et al., 2023), especially in writing (Crossley et al., 2022).

The learner's skill when producing written arguments has been a topic of interest in educational research (Reznitskaya et al., 2001), and Toulmin's Argument Pattern (TAP; Toulmin, 1958) has been one of the most widely used approaches to explore argumentation (Crossley et al., 2022; Erduran, 2007). According to Crossley et al. (2022), TAP's transdisciplinary nature has helped it become universally accepted for the examination of the fundamental microstructure of arguments in a logical manner (Sampson & Clark, 2008). TAP represents argumentation as the interconnected structure of certain elements of argumentation: "a *claim*; *data* that support that claim; *warrants* that provide a link between the data and the claim; *backing* that strengthens the warrants; and finally, *rebuttals*, which point to the circumstances under which the claim would not hold true" (Erduran, 2007, p. 57).

Authors' version

Previous literature suggests distinctions between primary and secondary elements of argumentation (Qin & Karaback, 2010). For example, it is necessary to the argument structure to produce claims and data, whereas counterarguments, warrants and rebuttals are normally produced by more expert writers (Crammond, 1998; Liu & Stapleton, 2014). Consequently, counterarguments can be understood as secondary in nature and dependent on the complexity of argumentation (Qin & Karaback, 2010). Much research has focused on using TAP to assess student written scientific argumentation (Erduran, 2007), and most of this research has revealed that students fail to produce sufficiently persuasive arguments (Bell & Linn, 2000; Sandoval, 2003). Often-reported findings are that students regularly make claims without providing explicit justification for them (Erduran et al., 2004; Jiménez-Aleixandre et al., 2000; Kelly et al., 1998), that they regularly fail to make explicit links between claims and data (Kelly & Takao, 2002; Takao & Kelly, 2003), and that they fail to produce sufficient warrants (Sandoval & Millwood, 2005), counterarguments or rebuttals (Kuhn & Modrek, 2021; Qin & Karaback, 2010). Due to the challenge that students face when producing arguments, Qin and Karaback (2010:454) indicate that teachers are responsible for "introducing and explaining the Toulmin model to students [...] and thereby enhance their awareness of all the Toulmin elements".

Previous studies manifest that specific CDFs and their members need to be defined and operationalised (Gerns, 2023b), so that students' subject-specific academic language can be described (Lorenzo & Trujillo, 2017). Such descriptions will inform the instructional approaches used for certain CDFs, a matter that remains under-researched. To our knowledge, few interventional studies have been conducted on the effect of teaching CDFs, with only five published studies (Breeze & Gerns Jiménez-Villarejo, 2019; Gerns, 2023a, 2023b; Nashaat-Sobhy, 2018; Roca de Larios et al., 2023) that focus on teaching students how to produce certain CDFs, all of them in English CLIL contexts. These studies focus on teaching *reporting* (Roca de Larios et al., 2023), *defining* (Nashaat-Sobhy, 2018), *describing* and *explaining* (Breeze & Gerns Jiménez-Villarejo, 2019) and *comparing* (Gerns, 2023a, 2023b). All found a positive impact of CDF instruction on students' written production. Among the aforementioned

Authors' version

studies, only those by Gerns (2023a, 2023b) used a control group and therefore, experimental research exploring the effects of CDF instruction remains scarce. Further exploration is required to determine whether all CDFs can be taught effectively by focusing on both discourse and subject-related content.

As mentioned above, some efforts to explore the production of CDFs in CLIL (e.g., Morton, 2020) have been made. However, scientific argumentation has been studied primarily in students' L1 (Erduran, 2007). CDFs and scientific argumentation have been rarely studied in other linguistic contexts, such as minority language contexts, or those in which students have considerable exposure to the language of instruction.

This study aims to respond to these needs by exploring the effects of CDF instruction, specifically of *arguing*, on the written production of specific CDFs in Model D in Secondary Education. The present study, therefore, addresses the aforementioned gaps and investigates the effects of an experimental intervention focusing on scientific argumentation in Secondary Education in a Basque medium of instruction setting.

Research Question

The present study explores the instruction of argumentative writing, and its effects on students' written production of scientific argumentation in Basque-medium education. The elaborateness of the students' production was measured based on the number of specific argumentation elements that make up the CDF sub-form *argue*. This study is guided by the following research question: *Does instruction on argumentation have an effect on students' production of argumentation elements?*

Taking into consideration the above-mentioned findings, we pose the question of whether instruction on scientific argumentation has a positive effect on students' production of argumentation elements. Although previous literature has found that CDF instruction has a positive effect overall, the effects of instruction in a minority language medium of instruction program from a disciplinary perspective are not yet fully understood. Therefore, we hypothesise

Authors' version

that instruction on argumentation in Basque-medium education would have a positive effect on students' production of argumentation elements.

Methods

Participants

At the time of the study, all participants (*N* = 105) were living in the Basque Autonomous region and were all Year 8 students (13-14 years old) enrolled in Basque Model D. Student participants were recruited through collaboration agreements between the Faculty of Humanities and Education Sciences (Mondragon University) and the participating schools. We contacted the four participating schools, which all belonged to the same school network and thus shared teaching methods, materials, curriculum approaches and content planning. After describing the project to the schools and asking for their participation, schools accepted to take part and each selected a participating class.

Students whose parents or guardians approved of their participation were encouraged to take part in the study, though they could opt out at any moment. All students tested in the 2020–2021 academic year were assigned to the control group, and all those tested in the 2021–2022 academic year were assigned to the experimental group.

The control group consisted of *n* = 74 students from three different schools in the Basque Autonomous region. However, only 47 completed all tasks in both pre- and post-sessions and were thus included in the final dataset. For the experimental group, the same three schools participated, in addition to a fourth added due to the loss of longitudinal data and to add statistical power to the analyses. A total of 105 students from these four schools took part in the experiment group in the 2021–2022 academic year. Of these, 62 students completed all the required tasks in both the pre- and post-assessments and were thus included in the dataset.

Every participant reported having either Basque (23.89%), Spanish (67.25%), or both (8.85%) as their home language, but to control for any potential background linguistic differences, the participants' knowledge in Basque, Spanish, and English was assessed by

Authors' version

means of the LexTale task in the three languages (de Bruin et al., 2017; Izura et al., 2014; Lemhöfer & Broersma, 2012). In this task, participants are presented with words and pseudowords in each language, and they are required to indicate whether or not each given word is a real word. Based on their responses, each participant gets a final score between -1 (fails all) and 1 (gets all correct). For further details see de Bruin et al. (2017). As an exclusion criterion, participants with scores lower than 0.2 in the Basque Lextale task were removed from the dataset (3.6% of the set), yielding a final set of 105 participants, 44 in the control group and 61 in the experimental group. This decision was based on the assumption that these students would have difficulties both when performing the written task and when following the intervention in the language of instruction. The two groups did not differ significantly in their knowledge in any of the languages (all ps > 0.3), showing a mean value of 0.55 (SD = 0.15) in Basque, 0.66 (SD = 0.20) in Spanish, and 0.17 (SD = 0.16) in English. Paired sample t-tests indicated that students were more proficient in Spanish than in Basque in both the control and experimental groups (all ps < .01). Nevertheless, despite Basque being the L2 for the majority of participants, all students had reached a minimum level of competence in Basque to be able to comprehend subject matter in that language. In other words, they had attained instructional language proficiency (Rolstad, 2015).

Materials and Procedure

As mentioned above, the guiding question of this project was whether the students' scientific writing would include more argumentative elements after they had been directly taught how to use these elements in relation to the subject content, as compared to students who had only being exposed to the content.

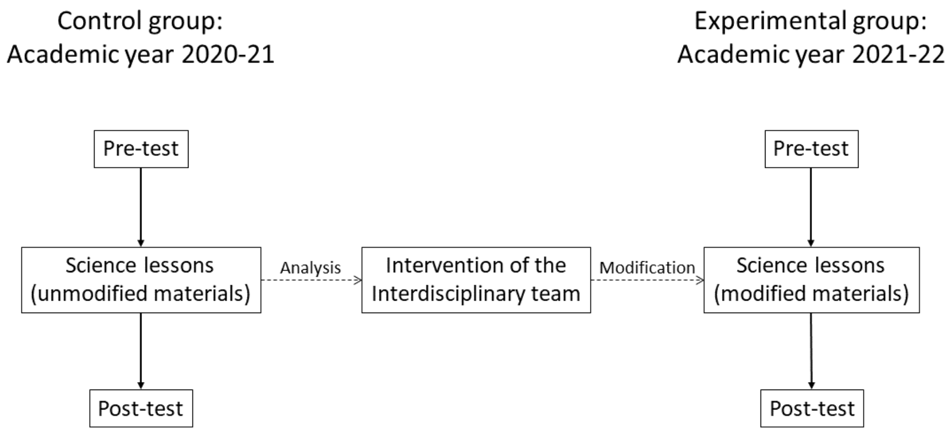
Thus, the study included two groups: a control group that received the standard teaching unit on renewable energies and an intervention group that also received explicit instruction on argumentation. The two groups were tested in two different academic years (2020–2021 for the control group, and 2021–-2022 for the experimental group), and both groups were tested twice—once prior to the instruction of the critical series of lessons on renewable energies and

Authors' version

once after it (henceforth, pre- and post-testing, respectively). The control group was taught the unit about renewable energies without modifications, while the experimental group received instruction on renewable energies with modifications to include further instruction on scientific argumentation. The time between pre- and post-sessions was approximately three months for both groups (see Figure 1).

Figure 1

Schematic representation of the experimental procedure



The pre-test and the post-test each lasted three hours, and participants were tested via Google Forms in the classroom, all at the same time and each with their own computer. A researcher was present at all times to ensure that there was no communication or sharing of information among students and that everything was properly understood. After the researcher introduced themselves and the project, the participants were sent an email with access to the task in Google Forms. This was done in free text response via Google Forms. The post-test was a replication of the pre-test immediately following the unit instruction.

The Instruction

All groups used the same teaching materials including the same science textbook oriented towards competence-based education. The materials were in Basque and focused on energy sources and their use. The unit was organised as a three-month-long project whose objective was for students to “investigate energy sources, energy characteristics and energy use; to critically express measures that would be sustainable and efficient, obtaining and comparing the necessary information” (IKASELKAR, 2016, p. 2). The control group completed the unit as it was in the original content materials, and the experimental group’s materials were modified to include explicit instruction in argumentation. This is further explained below.

Thus, throughout the length of the project, researchers, the four science schoolteachers of the selected classrooms, and the two designers of the original science textbooks (i.e., the interdisciplinary group) collaborated to adapt the teaching materials used to cover the unit so that subject-specific literacies were taught. After a preliminary analysis of the teaching material following Lersundi (2023), the interdisciplinary group, adapted and re-designed the teaching materials during six collaborative working sessions.

The interdisciplinary group proposed modifications to include instruction on academic language and, specifically, argumentation in a scientific education context at its core. It was concluded that, although argumentation was present in the original unmodified materials, the textbook did not explicitly instruct scientific argumentation. Consequently, three new one-hour sessions were designed to instruct students on scientific argumentation. Following Gerns (2023b), the CDF teaching was integrated and contextualised within the project. All teaching was conducted by the science teachers participating in the project and during the usual science teaching hours at each school (three hours per week).

The first instruction in argumentation took place in the middle of the project once students had acquired basic knowledge pertaining to renewable energy sources and energy transformation. To scaffold the teaching of TAP, a handout was prepared that provided definitions of claims, data, warrants and rebuttals along with schematic exemplifications. Once students’ awareness about scientific argumentation had been raised, a scientific argumentative model text was used, for which students were asked to (a) justify whether the author of the text

Authors' version

successfully defended their opinion and (b) identify Toulmin's elements in the text. The teachers and students co-corrected and discussed the text together.

The second session focused on the lexicogrammatical choices used to express cause and effect in Basque, mainly focusing on discourse markers (e.g., *horregatik, horrenbestez, -elako,* because, consequently), lexical items (e.g., *ondorio, kausa, eragin,* results, cause and effect) and syntactic structures (e.g., *nahiz eta…-n, egia da…*, it is true that…). To put these into practice, a digital interactive simulation task was used in which students were asked to explain the processes of energy transformation using the lexicogrammatical resources taught after combining energy transformation approaches (e.g., solar panels, batteries, and human force) to assess their effects on each other.

The third session was conducted at the end of the project after students had learnt about energy sources and conducted a small investigation on their characteristics. The principal aim of the session was for students to orally present the results of their investigations and compare renewable and non-renewable energy sources by providing evidence for and against each. The students were explicitly asked to use data and evidence to support their claims, and the teacher provided feedback during the oral presentations, especially aiming at encouraging the students to justify their opinions.

Data Analysis

The texts written in the pre- and post-sessions by the 105 students were collected, and the 210 total texts in Basque (105 in each testing point) were analysed by three researchers with language and science education backgrounds. The three researchers jointly analysed twenty percent of the texts in order to establish the analysis criteria. The three researchers addressed and resolved any disagreements or doubts that arose and made final decisions on the coding scheme. After complete agreement and establishment of the criteria, one of the researchers, a linguistic expert on CDFs, analysed the rest of the corpus. For the purposes of this study, only results written in Basque were considered.

Authors' version

A modified Toulmin's Argumentation (1958) model was used to identify the argumentation elements in students' productions. For this analysis, claims, data, warrants, backings and rebuttals were identified in the corpus. Table 2 provides definitions and examples of each element. Following previous studies using Toulmin's model (Crossley et al., 2022; Erduran, 2007; Liu & Stapleton, 2014; Qin & Karaback, 2010), the frequencies of each element were identified in the texts. The students in this study did not produce backings. Therefore, only the other four elements were considered.

Table 2

Examples and definitions of each argumentation element

Element	Definition	Example
Claim	The opinion or assertion of a learner towards the topic	Ex1. The best energy sources for our school are renewable ones.
Data	Evidence supporting the claim	Ex2. In the school, for example, we use a lot of energy every day and we mostly use energy that is not renewable and pollution grows. If we keep on like that pollution will go up and the world will be very polluted.
Warrant	Justifications of how the data support a specific claim	Ex3. To start, by using non-renewable energies we are harming the world. This is happening because the fossil fuels produce CO_2 and sulfur, and those create acid rain and increase the greenhouse effect.
Rebuttal	Statements refuting the claim	Ex4. Perhaps using renewable energy is more expensive, but we would be helping the world and once they are installed they are cheaper than traditional energies.

Authors' version

Note: Adapted from "Argumentation features and essay quality: Exploring relationships and incidence counts" by S. A., Crossley, Y. Tian and Q. Wan, 2022, *Journal of Writing Research*, *14*(1), p. 11 (https://doi.org/10.17239/jowr-2022.14.01.01). Examples are translated unaltered versions of students' texts.

The first step in the analysis was identifying whether the students' texts contained a claim or not. Both explicit and implicit claims (Simon, 2008) were counted. If a text lacked a claim, it was labelled as an expository text and discarded. The texts that did contain a claim were then analysed for data, warrants and rebuttals.

Next, the number of representations of each argumentation element (claims, data, warrant, and rebuttal) was coded. It is important to note that repetitions were not considered as different entities, and therefore pieces of the same information written more than once were counted only once. As warrants represent justifications and connections between claims and supporting data (García-Mila & Andersen, 2007), they were counted as connected to a certain data element (e.g., D1W, D2W). If a student used more than one warrant, but they used it for only a single unit of data, it was counted as one warrant (D1W and not D1W1, D1W2). In the 105 pre-test written productions, 101 texts contained at least one claim, 97 contained at least one piece of data, 36 included at least one warrant, and 14 showed at least one rebuttal. Out of the 105 post-test productions, 103 contained at least one claim, there were 101 texts with at least one piece of data, 41 backed them up with at least one warrant, and 34 texts included at least one rebuttal.

Authors' version

Table 3

Number and percentage of texts including each argumentation element

	Claim		Data		Warrant		Rebuttal	
Group	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Pre-test	101	96.19	97	92.38	36	34.28	14	13.33
Post-test	103	98.09	101	96.19	41	39.05	34	32.38

The researchers also found partial data and rebuttals. These were defined as structurally correct or close-to-correct statements in the form of data or a rebuttal, but they were judged as not acceptable (Sampson & Clark, 2008; Schwarz et al., 2003). They were assessed by a science education researcher who marked them as acceptable or unacceptable. For example, one participant wrote that "renewable energies need to be used because we have problems with the WiFi connection." This was marked as partial data. Similarly, unacceptable or incomplete rebuttals that provided counterarguments but were not refuted were marked as partial rebuttals (for example, "Secondly, it is true, we need to create and care for a lot of things, but, well, make an effort and everything will be better for us, for our school and for you").

Repeated measures analysis of variance (ANOVA) with a 2 (Testing time point: pre-test|post-test) by 2 (Group: control|experimental) design was conducted to compare the frequencies of the production of argumentation elements across groups. Testing time point was included as a within-subjects measure, group as a between-subjects measure, and the counts of each argumentation element as dependent variables.

Authors' version

Results

When the number of different claims was analysed, the ANOVA neither showed a main effect for testing time nor for group (all *p*s > .4), but it showed a significant interaction between them [$F(1, 103) = 9.83$, $p < .01$]. Planned comparisons indicated that, for the control group, the number of claims significantly decreased from before intervention (M = 1.64, SD = 0.53) to after intervention (M = 1.36, SD = 0.57, $t(103) = 2.57$, $p < .02$). However, the experimental group showed a marginally significant increase from before intervention (M = 1.39, SD = 0.59) to after intervention (M = 1.56, SD = 0.50, $t(103) = 1.82$, $p < .08$).

Next, the number of different data was compared across groups. The ANOVA showed a significant effect for Testing Time Point [$F(1, 103) = 5.14$, $p < .03$], indicating an increase from the pre-test (M = 2.33, SD = 1.57) to the post-test (M = 2.76, SD = 1.51); and a marginal effect for group ($p < .07$), but the interaction was not significant [$F(1, 103) = 0.17$, $p > .6$]. Planned comparisons indicate that, for the control group, there was no significant change between the pre-test text (M = 2.64, SD = 1.67) and the post-test text (M = 2.98, SD = 1.75, $t(103) = 1.22$, $p > .23$). The experimental group, however, showed a significant increase from before intervention (M = 2.11, SD = 1.47) to after intervention (M = 2.61, SD = 1.31, $t(103) = 2.07$, $p < .05$).

The number of different warrants was also compared across groups. The ANOVA showed no significant effect for either Testing Time Point or Group (all *ps* > .18), but the interaction was found to be significant [$F(1, 103) = 6.68$, $p < .02$]. Planned comparisons showed that, for the control group, there was a marginally significant decrease from the warrants presented in the pre-test text (M = 0.77, SD = 1.14) to those in the text after intervention (M = 0.46, SD = 0.85, $t(103) = 1.76$, $p < .09$). In contrast, the experimental group showed a marginally significant increase from before the intervention (M = 0.31, SD = 0.56) to after the intervention (M = 0.61, SD = 0.80, $t(103) = 1.92$, $p < .06$).

Finally, the number of different rebuttals was compared across groups. The ANOVA showed a significant effect of Testing Time Point [$F(1, 103) = 11.49$, $p < .01$], indicating an increase from the pre-test (M = 0.16, SD = 0.44) to the post-test (M = 0.42, SD = 0.70). There was no significant effect for Group, nor was there an interaction between the two main factors (all *ps* > .14). Planned comparisons showed no difference in rebuttals present in the pre-test text (M = 0.25, SD = 0.58) and the post-test text (M = 0.39, SD = 0.69, $t(103) = 1.26$, $p > .20$) for the control group. However, the experimental group showed a significant increase from before

Authors' version

the intervention (M = 0.10, SD = 0.30) to after the intervention (M = 0.44, SD = 0.72, $t(103) = 3.75$, $p < .01$).

Exploratory ANOVAs were run as well to see whether there was any difference in the partial data and partial rebuttals produced by the participants. An ANOVA on the partial data showed a main effect of Testing Time Point [$F(1, 103) = 11.49$, $p < .01$], indicating a decrease from the pre-test (M = 0.16, SD = 0.37) to the post-test (M = 0.06, SD = 0.23). There was no significant effect for Group, nor was there an interaction between the two main factors (all *ps* > .50). An ANOVA on partial rebuttals indicated that the only marginally significant effect was for Group [$F(1, 103) = 3.16$, $p < .08$, all other *p*s > .7], showing that the experimental group produced fewer partial rebuttals (M = 0.01, SD = 0.09) than the control group (M = 0.05, SD = 0.21).

Thus, as can be seen in Table 3 below, the experimental group showed a significant or marginally significant post-intervention improvement in the measures of claim, data, warrant, and rebuttal, while the control group showed a decrease in their use of claims and warrants, with no significant changes in the other measurements.

Table 4

Descriptive statistics of the control and experimental groups before and after intervention.

	Claim		Data		Warrant		Rebuttal	
Group	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
Experimental	1.39 (0.585)	1.56 (0.501)	2.11 (1.47)	2.61 (1.31)	0.311 (0.564)	0.607 (0.802)	0.0984 (0.3)	0.443 (0.719)
Control	1.64 (0.532)	1.36 (0.574)	2.64 (1.67)	2.98 (1.75)	0.773 (1.14)	0.455 (0.848)	0.25 (0.576)	0.386 (0.689)

Authors' version

Discussion

This study aimed to explore the effects, from a structural perspective, of scientific argumentation instruction on students' written production of scientific argumentation (Crossley et al., 2022; Toulmin, 1958). To the best of our knowledge, this is the first time that the effects of integrated academic language and content teaching have been observed in a Basque medium of instruction context following the modification of existing teaching materials.

First, our study demonstrated that students in the experimental group (i.e, those who received explicit teaching on scientific argumentation) improved significantly in their argumentative written production from the pre-test to the post-test. The control group, however, did not show significant improvements in their argumentation skills after being taught only the subject-content. This might suggest that content teaching is not sufficient for the development of students' argumentation skills and, as Gerns (2023a, p. 65) points out, CDF mastery is challenging for students when "left on their own." The present study also supports the claim that CDFs *can* and *must* be taught to students, as suggested by previous instructional studies focusing on different CDFs (Breeze & Gerns Jiménez-Villarejo, 2019; Gerns 2023a, 2023b; Nashaat-Sobhy, 2018; Roca de Larios et al., 2023), since the results show that instruction helped students to produce them. Furthermore, in line with Roca de Larios et al. (2023), instruction that combines CDFs and disciplinary language has been shown to be beneficial for scaffolding the structural features of argumentative writing. Our findings seem to suggest that the approaches used in the classroom in the present study may have helped raise the students' metalinguistic and discursive awareness of the CDF or genre (Santiago Schwarz & Hamman-Ortiz, 2020), and consequently they were able to provide subject-specific justifications through arguments (Whittaker & McCabe, 2023).

Our study supports claims suggesting the importance of teaching disciplinary literacies (Llinares et al., 2012; Shanahan & Shanahan, 2008; 2012) while providing students with contexts in which they can develop their academic language proficiency in the language of instruction (Cummins, 2021). It can be assumed that instructional approaches combining

Authors' version

scientific argumentation skills alongside content teaching are beneficial for raising students' awareness of all elements of argumentation, while focusing on content alone might lead only to fewer incorrect pieces of information. In line with Qin and Karaback (2010), we see that it is the teachers' responsibility to instruct students in the use of Toulmin's model, and it is content teachers who should be including specific disciplinary conventions (i.e., scientific argumentation) in their subject teaching in order to help their students become pluriliterate in their subject (Coyle & Meyer, 2021).

Second, previous research has highlighted the importance of characterising and providing analytical frameworks for CDFs and their subforms (Dalton-Puffer, 2013; Gerns, 2023b). The present study further contributes to the mapping of the CDF subform *argue,* through the use of Toulmin's proposal, both in the instructional design and in the analysis of students' production. TAP has been universally used to capture the structural features of argumentation (see e.g., Crossley et al., 2022), and has been proven suitable for understanding students' argumentative writing from a structural-discourse perspective. It is our belief that TAP offers an interesting path for the exploration of scientific argumentation in educational contexts as, in line with Liu and Stapleton (2014), Crammond (1998) and Arias-Hermoso et al. (2024), the model includes elements basic to argumentation (such as claims and data) as well as more complex elements (such as warrants and rebuttals). Our study thus demonstrates the usefulness of TAP for both teaching and research purposes.

Finally, the present results clearly show that CDF teaching is possible in immersion programmes, where the language of instruction is a minority language and a second language for the majority of students. Despite Basque not being the dominant language of most participants, and the LexTale test showing an overall lower proficiency than in Spanish, the participants were objectively able to produce more complex argumentative compositions after experimental intervention. These findings are consistent with previous instructional CDF research in CLIL contexts (Breeze & Gerns Jiménez-Villarejo, 2019; Gerns, 2023a, 2023b; Nashaat-Sobhy, 2018; Roca de Larios et al., 2023). Although some differences between CLIL

Authors' version

and immersion/CBI programmes have been acknowledged (Dalton-Puffer et al., 2014), our study sheds light on some of their similarities, especially on integration (Cenoz, 2015; Nikula et al., 2016). Indeed, Cenoz (2015) points out that an exploration of integration at different levels is needed for successful CLIL/immersion programmes, regardless of whether the language of instruction is the L1, L2 or FL (Beacco et al., 2016; Lorenzo & Trujillo, 2017).

Conclusions, future research, limitations and implications

The findings of the present study have led us to draw several conclusions regarding students' written argumentation in secondary education science. This study contributes to further developing the CDF construct in multilingual settings, as it has been shown that teaching a CDF can positively influence a learner's production of that particular CDF. It could be concluded that re-designing teaching materials and classroom interventions with a focus on disciplinary CDFs helped students improve their argumentation skills. The present study has contributed fresh perspectives regarding the teaching of argumentation to secondary students when the language of instruction is a minority one.

There are certain limitations to this study. First, due to the COVID-19 health restrictions, the number of final participants completing all tests was severely reduced (approximately thirty percent of the students). As explained above, a further school to the experimental group was added to gain statistical power. Another challenge previously addressed was the ambiguity of students' production of argumentation elements (Simon, 2008; Qin & Karaback, 2010), which complicated the coding process. Furthermore, this study included only the frequencies of argumentation elements, while argumentation quality and the lexicogrammatical forms used by students to produce their arguments were not analysed, a limitation previously acknowledged by other studies (Crossley et al., 2022; Qin & Karaback, 2010).

Some implications, both theoretical and pedagogical, can be drawn from the findings of the present study. At the theoretical level, this research has proven the usefulness of TAP, a

Authors' version

universally recognised model, to map the CDF *argue*. Future research could further develop TAP as an approach to explore CDF productions by examining the specific lexicogrammar used to express argumentation, or by expanding Toulmin's model and combining it with the *Appraisal* framework, used elsewhere to analyse CDF production (Llinares & Nashaat-Sobhy, 2023; Llinares & Nikula, 2023). This study also reveals several pedagogical implications that suggest the need for integrated content and language pedagogical approaches, curriculum and assessment (Nikula et al., 2016). More specifically, materials that address the integration of disciplinary language need to be consciously designed (Banegas, 2012; Lersundi, 2023) to foster students' disciplinary literacies while addressing subject-content.

Finally, with a view to exploring whether all CDFs can be taught, future studies could consider the teaching of other CDFs, in addition to those addressed in this study and elsewhere (e.g., Breeze & Gerns Jiménez-Villarejo, 2019; Gerns, 2023a, 2023b; Nashaat-Sobhy, 2018; Roca de Larios et al., 2023). As a final remark, it is important to highlight that this study has shown that collaboration among content teachers, material designers and researchers can benefit students' learning. This opens a path for further research and collaboration opportunities in which practitioners and researchers engage equally, something that could benefit all parties involved in the teaching-learning process (Banegas & Mearns, 2023).

Authors' version

References

Aldekoa, A., Manterola, I. & Idiazabal, I. (2020). A trilingual teaching sequence for oral presentation skills in Basque, Spanish and English. *The Language Learning Journal*, *48*(3), 259–271. https://doi.org/10.1080/09571736.2020.1741666

Arias-Hermoso, R., Imaz Agirre, A., & Garro Larrañaga, E. (2024). A comparison between input modalities and languages in source-based multilingual argumentative writing. *Assessing Writing*, *60*, 100813. https://doi.org/10.1016/j.asw.2024.100813

Asterhan, C., & Schwarz, B. (2016). Argumentation for learning: Well-trodden paths and unexplored territories. *Educational Psychologist*, *51*(2), 164–187. https://doi.org/10.1080/00461520.2016.1155458

Bailey, A. L., & Butler, F. (2003). An evidentiary framework for operationalizing academic language for broad application to K–12 education: A design document (CSE Report 611). *Education*, *1522*(310), 1–44. https://cresst.org/wp-content/uploads/R611.pdf

Banegas, D. L. (2012). CLIL teacher development: Challenges and experiences. *Latin American Journal of Content & Language Integrated Learning*, *5*(1), 46–56. https://doi:10.5294/laclil.2012.5.1.4

Banegas, D. L., & Mearns, T. (2023). The language quadriptych in content and language integrated learning: Findings from a collaborative action research study. *Journal of Multilingual and Multicultural Development.* Advance online publication. https://doi.org/10.1080/01434632.2023.2281393

Beacco, J. C., Fleming, M., Goullier, F., Thurmann, E., & Vollmer, H. (2016). *A handbook for curriculum development and teacher training: the language dimension in all Subjects*. Council of Europe. https://rm.coe.int/a-handbook-for-curriculum-development-and-teacher-training-the-languag/16806af387

Authors' version

Bell, P., & Linn, M. C. (2000). Scientific arguments as learning artifacts: Designing for learning from the web with KIE. *International Journal of Science Education*, *22*(8), 797–817. https://doi.org/10.1080/095006900412284

Breeze, R., & Gerns Jiménez-Villarejo, P. (2019). Building literacies in secondary school history: The specific contribution of academic writing support. *EuroAmerican Journal of Applied Linguistics and Languages*, *6*(1), 21–36. http://dx.doi.org/10.21283/2376905X.10.149

Cenoz, J. (2015). Content-based instruction and content and language integrated learning: The same or different? *Language, Culture and Curriculum*, *28*(1), 8–24. https://doi.org/10.1080/07908318.2014.1000922

Cenoz, J. (2023). Plurilingual education in the Basque Autonomous Community. In J. M. Cots (Ed.), *Profiling plurilingual education: A pilot study of four Spanish autonomous communities* (pp. 33–53). Edicions de la Universitat de Lleida.

Colmenero, K., & Lasagabaster, D. (2023). Native and non-native teachers in a minority language: An analysis of stakeholders' opinions. *International Journal of Bilingualism, 28*(2), 1–16. https://doi.org/10.1177/13670069221149671

Council of Europe. (2017). *December 2017 Council Conclusions*. Retrieved: https://www.consilium.europa.eu/media/32204/14-final-conclusions-rev1-en.pdf

Coyle, D., & Meyer, O. (2021). *Beyond CLIL: Pluriliteracies teaching for deeper learning*. Cambridge University Press.

Crammond, J. (1998). The uses and complexity of argument structures in expert and student persuasive writing. *Written Communication, 15*(2), 230–268. https://doi.org/10.1177/0741088398015002004

Crossley, S. A., Tian, Y., & Wan, Q. (2022). Argumentation features and essay quality: Exploring relationships and incidence counts. *Journal of Writing Research*, *14*(1), 1–34. https://doi.org/10.17239/jowr-2022.14.01.01

Authors' version

Cummins, J. (1984). *Bilingualism and special education: Issues in assessment and pedagogy*. Multilingual Matters.

Cummins, J. (2021). *Rethinking the education of multilingual learners: A critical analysis of theoretical concepts*. Multilingual Matters.

Dalton-Puffer, C. (2007). *Discourse in Content-and-Language-Integrated Learning (CLIL) Classrooms*. John Benjamins. https://doi.org/10.1075/lllt.20

Dalton-Puffer, C. (2013). A construct of cognitive discourse functions for conceptualising content-language integration in CLIL and multilingual education*. European Journal of Applied Linguistics, 1*(2), 216–253. https://doi.org/10.1515/eujal-2013-0011

Dalton-Puffer, C. (2016). Cognitive discourse functions: Specifying an integrative interdisciplinary construct. In T. Nikula, E. Dafouz., P. Moore, & U. Smit (Eds.), *Conceptualising integration in CLIL and multilingual education* (pp. 29–54). Multilingual Matters. https://doi.org/10.21832/9781783096145-005

Dalton-Puffer, C., & Bauer-Marschallinger, S. (2019). Cognitive discourse functions meet historical competences: Towards an integrated pedagogy in CLIL history education. *Journal of Immersion and Content-Based Language Education, 7*(1), 30–60. https://doi.org/10.1075/jicb.17017.dal

Dalton-Puffer, C., Llinares, A., Lorenzo, F., & Nikula, T. (2014). "You can stand under my umbrella": Immersion, CLIL and bilingual education. A response to Cenoz, Genesee & Gorter (2013). *Applied Linguistics*, *35*(2), 213–218. https://doi.org/10.1093/applin/amu010

de Bruin, A., Carreiras, M., & Duñabeitia, J. A. (2017). The BEST dataset of language proficiency. *Frontiers in Psychology, 8*, 1–7. https://doi.org/10.3389/fpsyg.2017.00522

Erduran, S. (2007). Methodological foundations in the study of argumentation in science classrooms. In S. Erduran & M. P. Jiménez-Aleixandre (Eds.), *Argumentation in Science Education* (pp. 47–69). Springer.

Authors' version

Erduran, S., Simon, S., & Osborne, J. (2004). TAPping into argumentation: Developments in the application of Toulmin's Argument Pattern for studying science discourse. *Science Education, 88*(3), 915–933. https://doi.org/10.1002/sce.20012

EUSTAT (2023). Students enrolled in Obligatory Secondary Education (ESO) by language model in the Basque Country. _Retrieved from: https://en.eustat.eus/indic/indicadoresgraficosvista.aspx?idgraf=16358&opt=0&tem=300

Ferretti, R. P. & Fan, Y. (2016). Argumentative writing. In C. A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp. 301–315). The Guilford Press.

García-Mila, M. & Andersen, C. (2007). Cognitive foundations of learning argumentation. In S. Erduran & M. P. Jiménez-Aleixandre (Eds.), *Argumentation in science education* (pp. 29–45). Springer.

Gerns, P. (2023a). Building scientific knowledge in English: Integrating content, cognition and communication in secondary school CLIL biology. *Journal of Language and Education, 9*(3), 52–78. https://doi.org/10.17323/jle.2023.17569

Gerns, P. (2023b). Qualitative insights and a first evaluation tool for teaching with cognitive discourse function: “Comparing” in the CLIL science classroom. *Porta Linguarum, 40*, 161–179. https://doi.org/10.30827/portalin.vi40.26619

IKASELKAR. (2016). EKI *Proiektua. NATuraren zientziak: energiaren beharra, arazo iturri (irakasleentzako gida).* [Translated title: EKI Project. Nature Science: the need for energy, a source of problems (teachers’ guide)].

Izura, C., Cuetos, F., & Brysbaert, M. (2014). Lextale-Esp: A test to rapidly and efficiently assess the Spanish vocabulary size. *Psicológica, 35*, 49–66.

Jiménez-Aleixandre, M. P., Bugallo Rodríguez, A. & Duschl, R. A. (2000). “Doing the lesson” or “doing science”: Argument in high school genetics. *Science Education, 84*(6), 757–792.

Authors' version

Jiménez-Aleixandre, M. P., & Erduran, S. (2007) Argumentation in science education: An overview. In S. Erduran & M. P. Jiménez-Aleixandre (Eds.) *Argumentation in science education* (pp. 3–27). Springer.

Kelly, G. J., Druker, S., & Chen, C. (1998). Students' reasoning about electricity: Combining performance assessments with argumentation analysis. *International Journal of Sciences Education, 20*(7), 849–871. https://doi.org/10.1080/0950069980200707

Kelly, G. J., & Takao, A. (2002). Epistemic levels in argument: An analysis of university oceanography students' use of evidence in writing. *Science Education, 86*(3), 314–342. https://doi.org/10.1002/sce.10024

Kuhn, D. & Modrek, A. S. (2021). Choose your evidence. Scientific thinking where it may most count. *Science & Education, 31*, 21–31. https://doi.org/10.1007/s11191-021-00209-y

Lasagabaster, D., & Sierra, J. M. (2010). Immersion and CLIL in English: More differences than similarities. *ELT Journal, 64*(4), 367–375. https://doi.org/10.1093/elt/ccp082

Lemhöfer, K. & Broersma, M. (2012). Introducing LexTALE: A quick and valid lexical test for advanced learners of English. *Behaviour Research Methods*, *44*, 325–343 https://doi.org/10.3758/s13428-011-0146-0

Lersundi, A. (2023). *Arloetako alfabetatzearen azterketa batxilergoko diziplinarteko proiektu batean. Kasu azterketa.* [Unpublished doctoral dissertation, Mondragon University, Translated title: *Analysis of subject-specific literacies in a multidisciplinary project in upper-secondary education. Case study*]. https://hdl.handle.net/20.500.11984/5964

Li, X., Wang, W., & Li, Y. (2022). Systematically reviewing the potential of scientific argumentation to promote multidimensional conceptual change in science education. *International Journal of Science Education*, *44*(7), 1165–1185. https://doi.org/10.1080/09500693.2022.2070787

Liu, F., & Stapleton, P. (2014). Counterargumentation and the cultivation of critical thinking in argumentative writing: Investigating washback from a high-stakes test. *System*, *45*, 117–128.

Authors' version

Llinares, A., & McCabe, A. (2023). Systemic functional linguistics: The perfect match for content and language integrated learning. *International Journal of Bilingual Education and Bilingualism, 26*(3), 245–250. https://10.1080/13670050.2019.1635985

Llinares, A., Morton, T., & Whittaker, R. (2012). *The roles of language in CLIL*. Cambridge University Press.

Llinares, A., & Nashaat-Sobhy, N. (2023). CLIL students' academic language performance on a non-curricular topic: A comparison between high-exposure and low-exposure groups. *English Teaching & Learning, 47*, 337–358. https://doi.org/10.1007/s42321-023-00151-y

Llinares, A., & Nikula, T. (2023). CLIL students' production of cognitive discourse functions: Comparing Finnish and Spanish contexts. *Language and Education*. Advance online publication. https://doi.org/10.1080/09500782.2023.2211049

Lorenzo, F., & Rodríguez, L. (2014). Onset and expansion of L2 cognitive academic language proficiency in bilingual settings: CALP in CLIL. *System, 47*, 64–72. https://doi.org/10.1016/j.system.2014.09.016

Lorenzo, F., & Trujillo, F. (2017). Languages of schooling in European policymaking: Present state and future outcomes. *European Journal of Applied Linguistics, 5*(2), 177–197. https://doi.org/10.1515/eujal-2017-0007

Lorenzo, F. (2017). Historical literacy in bilingual settings: Cognitive academic language in CLIL history narratives. *Linguistics and Education, 37*, 32-41. https://doi.org/10.1016/j.linged.2016.11.002

Manterola, I., Almgren, M., & Idiazabal, I. (2012). Basque L2 development in immersion school settings. *International Journal of Bilingualism, 17*(3), 375–391. https://doi.org/10.1177/1367006912438996

Martín-Gámez, C., & Erduran, S. (2018). Understanding argumentation about socio-scientific issues on energy: A quantitative study with primary pre-service teachers in Spain.

Authors' version

Research in Science & Technological Education, *36*(4), 463–483. https://doi.org/10.1080/02635143.2018.1427568

Meneses, A., Montenegro, M., Acevedo, D., Figueroa, J., & Hugo, E. (2023). Cross-disciplinary language changes in 4th graders as a predictor of the quality of written scientific explanation. *Journal of Writing Research*. Advance online publication: https://www.jowr.org/index.php/jowr/article/view/1026

Morton, T. (2020). Cognitive discourse functions: A bridge between content, literacy and language for teaching and assessment in CLIL. *CLIL Journal of Innovation and Research in Plurilingual and Pluricultural Education*, *3(*1), 7–17. https://doi.org/10.5565/rev/clil.33

Nashaat-Sobhy, N. (2018). Operationalizing "defining" from a cognitive discourse perspective for learners' use. In S. M. Anwaruddin (Ed.), *Knowledge mobilization in TESOL: Connecting research and practice* (pp. 94–112). https://doi.org/10.1163/9789004392472_007

Nikula, T., Dalton-Puffer, C., Llinares, A., & Lorenzo, F. (2016). More than content and language: The complexity of integration in CLIL and bilingual education. In T. Nikula, E. Dafouz, P. Moore, & U. Smit (Eds.), *Conceptualising integration in CLIL and multilingual education* (pp. 1–26). Multilingual Matters. https://doi.org/10.21832/9781783096145-004

Pavón, V., & Pérez, A. (2017). Enhancing disciplinary literacies: Languages of schooling and whole-school language projects in Spain. *European Journal of Applied Linguistics*, *6*(1), 109–130. https://doi.org/10.1515/eujal-2017-0023

Polias, J. (2016). *Apprenticing students into science: Doing, talking & writing scientifically*. Lexis Education.

Qin, J., & Karabacak, E. (2010). The analysis of Toulmin elements in Chinese EFL university argumentative writing. *System*, *38*(3), 444–456. https://doi.org/10.1016/j.system.2010.06.012

Authors' version

Reznitskaya, A., Anderson, R.C., McNurlen, B., Nguyen-Jahiel, K., Archodidou, A., & Kim, S. (2001). Influence of oral discussion on written argument. *Discourse Processes*, *32*(2–3), 155–175. https://doi.org/10.1080/0163853X.2001.9651596

Roca de Larios, J., Coyle, Y., & Garcia, V. (2023). The effects of using cognitive discourse functions to instruct 4th-year children on report writing in a CLIL science class. *Studies in Second Language Learning and Teaching*, *12*(4), 597–622. https://doi.org/10.14746/ssllt.2022.12.4.4

Rolstad, K. (2015). Second language instructional competence. *International Journal of Bilingual Education and Bilingualism, 20*(5), 497–509. http://dx.doi.org/10.1080/13670050.2015.1057101

Sagasta, M. P. (2003). Acquiring writing skills in a third language: The positive effects of bilingualism. *International Journal of Bilingualism, 7*(1), 27–42. https://doi.org/10.1177/13670069030070010301

Sampson, V., & Clark, D. (2008). Assessment of the ways students generate arguments in science education: Current perspectives and recommendations for future directions. *Science Education*, *92*(3), 447–472. https://doi.org/10.1002/sce.20276

Sandoval, W. A. (2003). Conceptual and epistemic aspects of students' scientific explanations. *Journal of the Learning Sciences*, *12*(1), 5–51. https://doi.org/10.1207/S15327809JLS1201_2

Sandoval, W. A., & Millwood, K. A. (2005). The quality of students' use of evidence in written scientific explanations. *Cognition and instruction*, *23*(1), 23–55. https://doi.org/10.1207/s1532690xci2301_2

Sandoval, W. A., & Millwood, K. A. (2007). What can argumentation tell us about epistemology? In S. Erduran, & M. P. Jiménez-Aleixandre (Eds.) *Argumentation in Science Education* (pp. 3–27). Dordrecht: Springer.

Santiago Schwarz, V., & Hamman-Ortiz, L. (2020). Systemic functional linguistics, teacher education, and writing outcomes for U.S. elementary English learners: A review of the

Authors' version

literature. *Journal of Second Language Writing*, *49*, 100727. https://doi.org/10.1016/j.jslw.2020.100727

Schwarz, B. B., Neuman, Y., Gil, J., & Ilya, M. (2003). Construction of collective and individual knowledge in argumentation activity. *Journal of the Learning Sciences*, *12*(2), 219–256. https://doi.org/10.1207/S15327809JLS1202_3

Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content-area literacy. *Harvard Educational Review, 78*(1), 40–59. https://doi.org/10.17763/haer.78.1.v62444321p602101

Shanahan, T., & Shanahan, C. (2012). What is disciplinary literacy and why does it matter? *Topics in Language Disorders*, *32*(1), 7–18. https://doi.org/10.1097/TLD.0b013e318244557a

Simon, S. (2008). Using Toulmin's Argument Pattern in the evaluation of argumentation in school science. *International Journal of Research and Method in Education, 31*(3), 277–289. https://doi.org/10.1080/17437270802417176

Takao, A. Y., & Kelly, G. J. (2003). Assessment of evidence in university students' scientific writing. *Science & Education*, *12*, 341–363. https://doi.org/10.1023/A:1024450509847

Tang, K. S. (2019). The role of language in scaffolding content & language integration in CLIL science classrooms. *Journal of Immersion and Content-Based Language Education*, *7*(2), 315–328. https://doi.org/10.1075/jicb.00007.tan

Toulmin, S. (1958). *The Uses of Argument*. Cambridge: Cambridge University Press.

Whittaker, R., & McCabe, A. (2023). Expressing evaluation across disciplines in primary and secondary CLIL writing: A longitudinal study. *International Journal of Bilingual Education and Bilingualism, 26*(3), 345–362. https://doi.org/10.1080/13670050.2020.1798869

Authors' version

ABSTRACT IN BASQUE:

LABURPENA

Euskara bidezko irakaskuntza-programa batean bigarren hezkuntzako ikasleen idazkera zientifiko-argumentatiboan irakaskuntzak dituen ondorioak aztertzen ditu ikerketa sasi-esperimental honek. Bigarren Hezkuntzako ikasleek (N = 105) ikerketa lan honetako eginkizun gisa idatzizko atazak egin zituzten zientzia ikasgaiain energiari buruzko unitate bat landu aurretik eta ondoren. Talde esperimentalak (n = 61), unitateko lanketaz gainera, ordubeteko hiru saiotan Funtzio Kognitibo Diskurtsiboen (Dalton-Puffer, 2013) ikuspegitik argumentazio zientifikoa landu zuen, kontrol-taldeak (n = 44) energiari buruzko unitatea osatu zuen argumentazioari buruzko argibide gehigarririk gabe. 210 testuz osaturiko azken corpusa Toulmin’s Argumentation Pattern (1958) erabilita aztertu zen.

ANOVAk frogatu zuen talde esperimentalak hobekuntza esanguratsua izan zuela argumentazio-estrategien kopuruari dagokionez, eta kontrol-taldeak ez zuela estrategia horien erabilera handitu. Hortaz, emaitzek erakusten dute argumentazioa berariaz lantzea ikasleentzat lagungarri dela argudiozko testu hobeak idazteko. Ondorio horiek iradokitzen dute Funtzio Diskurtsibo Kognitiboen lanketak aukera ematen duela hezkuntza testuinguru elebidunetan hizkuntza akademikoa ikasteko. Ikerketa honen ondorio pedagogikoak eta etorkizuneko ikerketa ildoak ere eztabaidatzen dira.

HITZ GAKOAK

Argumentazioa, funtzio kognitibo diskurtsiboak, idazketa akademikoa, Bigarren Hezkuntza, euskara.

Authors' version

AUTHORS' E-MAIL & POSTAL ADDRESS

Eneritz Garro Larrañaga

egarro@mondragon.edu

Dorleta auzoa, z.g., 20.540 Eskoriatza, Spain

Eneko Antón

eanton@mondragon.edu

Dorleta auzoa, z.g., 20.540 Eskoriatza, Spain

Roberto Arias-Hermoso

rarias@mondragon.edu

Dorleta auzoa, z.g., 20.540 Eskoriatza, Spain

Unai Carmona

ucarmona@mondragon.edu

Dorleta auzoa, z.g., 20.540 Eskoriatza, Spain

Authors' version