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## Walton's types of argumentation dialogues as classroom discourse sequences

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## ABSTRACT

Dialogic argumentation has thus far been proposed as a way to analyse, understand, and promote meaningful classroom interactions. However, currently there is a lack of systematic proposals for conceptualising argumentation dialogue goals as part of teachers' pedagogical repertoire. Our main goal is to operationalise an existing framework of argumentation dialogue types, the one proposed by argumentation theorist Douglas Walton. To do so, we first identify a set of epistemic criteria for meaningful, from an argumentation point of view, discursive interactions, which we use as 'framing indicators' to enrich Walton's existing typology of four argumentation dialogues (information-seeking, inquiry, discovery, persuasion). We applied the resulting pragmatic framework to teacher-student interactions found in 20 transcripts of both science and social sciences secondary education lessons. We found that affordances for these four types of dialogues were also present in teacher-student discourse, where the implied argumentation goal was not fulfilled. We discuss these findings in terms of the need to be able to identify the dialogic potentiality and accountability within teacher-student interactions so that the argumentative potential of these interactions can be fulfilled, resulting in productive classroom discourse within secondary education classroom settings.

## 1. Introduction

During the last two decades, there has been an increasing need among educational researchers to analyse classroom discourse from an argumentation point of view (Asterhan & Schwarz, 2016; Driver, Newton, & Osborne, 2000). Several coding schemes have been developed focusing on discursive interactions among peers (e.g. Baker, 2003; Erduran, Simon, & Osborne, 2004), the assessment of students' argumentative competences (e.g., Rapanta, Garcia-Mila, & Gilabert, 2013; Erduran et al., 2004; Felton & Kuhn, 2001), or on the role of language as a tool for constructing understanding drawing on socio-cultural perspectives on learning and instruction (Hennessy et al., 2016; Lyle, 2008). As international research focuses more and more on dialogic and/or argument-based instruction (McNeill & Knight, 2013; Reznitskaya & Wilkinson, 2017; Sampson & Blanchard, 2012), the effort to define and identify what the implementation of productive pedagogical dialogue looks like is well justified (Gomez Zaccarelli, Schindler, Borko, & Osborne, 2018).

Educational argumentation has been defined as a constructive and productive dialogical interaction in which meanings, ideas,

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and solutions are negotiated until they arrive at a final “better” (more sophisticated, reasonable, explored) state (Baker, 2003; Felton, Garcia-Mila, Villarroel, & Gilabert, 2015). There are currently two main trends in the literature on what the main epistemic outcomes of educational argumentation should be: one focuses on “learning-to-argue”, while the other on “arguing-to-learn” (Andriessen & Baker, 2014; Von Aufschaiter, Erduran, Osborne, & Simon, 2008). In the former, the focus of implementing argumentation is the development of argumentation skills within the students, such as the construction of valid arguments, counter-arguments, and rebuttals and the appropriate use of evidence (Kuhn, 2005). In the latter, the focus is on conceptual learning, sometimes also referred to as “conceptual change” (Asterhan & Schwarz, 2009), as the result of students’ engagement in constructive, argumentative interactions. Although these two perspectives may guide research in the field, with studies being situated within one trend or the other, in practice they usually merge when teachers are the agents of argumentative interactions in their classrooms. In this case, both “learning-to-argue” and “arguing-to-learn” outcomes intermingle, as they both form part of the pedagogical objectives and outcomes of a learning interaction. The question is not to distinguish them, but to situate them within a dialogue frame, implied by the communication goals served by interaction at each moment.

According to Walton (2008) these dialogical interactions can take the form of different types of dialogues such as persuasion and inquiry, which serve different argumentation goals. Within educational argumentative interactions, persuasion is often considered as the key goal (e.g. Berland & Reiser, 2009); yet, persuasion is not the only communication goal to pursue, as implied by the Aristotelian tradition which sees argumentation as essentially dialectical (Blair & Johnson, 1987). When it comes to framing discussions as macro-dialogues (to be further explained below), inquiry has also been extensively studied as the most adequate goal for teacher-student argumentative discussions (Reznitskaya & Wilkinson, 2017). Further to inquiry and persuasion, deliberation is another extensively studied goal when it comes to peer-to-peer collaborative argumentative discussions (Felton, Crowell, Garcia-Mila, and Villarroel, in this issue; Felton, Garcia-Mila, & Gilabert, 2009). Finally, information-seeking and discovery dialogues were also proposed as “potentially argumentative” when it comes to pedagogical dialogues (Rapanta, 2018, a), indicating that there are multiple types of dialogues that are worth exploring within educational argumentation.

The aim of this study is to operationalise these types of dialogues as expressed within teacher-students’ potentially argumentative interactions. This methodological paper is divided as follows. We will first review the most relevant literature in the specific context of studying dialogue goals in relation to classroom argumentation. We will then describe epistemic criteria of both “learning to argue” and “arguing to learn” interactions, that may inform teacher-students’ whole-class interactions. These criteria will form ‘framing indicators’ which will enrich Walton’s existing typology of argumentation dialogues, and which will guide the empirical part of applying the proposed framework to a rich dataset of 20 transcribed middle-grade classes.

## 2. Literature review

### 2.1. Types of dialogue in educational settings

Dialogic teaching (Alexander, 2008) emphasizes dialogue as a central pedagogical tool for learning, instead of instructional practices dominated by teacher-centred monologue. In dialogic teaching, the focus is on the students and their agency in participating in dialogue, with or without teacher intervention, which is often limited to establishing dialogue norms in the classroom (Alexander, 2008; Mercer, Wegerif, & Dawes, 1999). In argument-based teaching the focus is on teachers fostering argument as “science talk” (Lemke, 1990), as a reasoning skill, or both, which might explain why the “arguing-to-learn” and the “learning-to-argue” goals in practice are often addressed simultaneously. The focus is on the use of dialogue as a means for achieving certain epistemic goals, instead of focusing on the experience of dialogue as a created space/opportunity for sharing and negotiating ideas. Better said, in argument-based teaching the creation of a “debate space” (Baker, 2009) should be a condition for genuine, constructive argumentation to take place, and not the goal per se.

Berland and Reiser (2009) discuss how teachers and students might adopt three different goals within an “arguing-to-learn” approach to science instruction. The first goal, sense-making, is defined as a process of using evidence to make sense of the phenomena investigated, and thus has an exploratory dimension to it. The second goal is articulating, which engages students in the process of exemplifying and operationalising their sense-making into verbal discourse through ‘talking science’. The third goal to achieve when engaging students in explanation and argumentation practices is persuasion, where students need to consider their articulated ideas hand-in-hand, evaluate them and engage in a social process of choosing which is the best explanation, and in that process persuade their peers and teachers. Berland and Reiser (2009) found that within an instructional unit consistent with argument-based instruction students were able to achieve the first two goals of sense-making and articulation of ideas and understandings, but they were less frequently engaging in persuasion. They explain these findings based on the challenges imposed on teachers and students within traditional classroom settings.

In fact, classroom discourse conducive to the use of argumentation dialogues is not frequently identified. For instance, Pimentel and McNeill (2013) found that the way in which secondary science teachers framed their lessons and the discourse moves they used during whole-class discussions did not encourage students to provide extensive answers to questions, which could make public their conceptual understanding, reasoning or misconceptions. Overall, they found that 87–100% of student contributions were limited to single or small phrases, with dialogue spaces shut down by teachers rather than opened-up. Similarly, Christodoulou & Osborne, 2014 examined a secondary school teacher’s interactions with students within a combined learning-to-argue and arguing-to-learn approach and found that the teacher’s talk was mainly characterised by talk moves that prompted students to provide factual information; in those instances where students were also prompted to engage in justificatory reasoning and critique each other’s ideas, congruent to Berland and Reiser’s (2009) persuasion goal, the quality of the discourse improved.

Recently, Reznitskaya and her colleagues (Reznitskaya & Wilkinson, 2017; Wilkinson et al., 2017) describe a specific type of argumentation dialogue called “inquiry dialogue”, as a macro-dialogue that guides teacher-student interactions. Their proposal emerged as a development of Gregory’s (2007) adaptation of Walton’s types of dialogue (see Section 3.1) to ‘Philosophy for Children’ sessions. Under their perspective, inquiry dialogue is the one with the greatest argumentative potential, as it aims at students’ “most reasonable answer” based on truth-seeking criteria (Reznitskaya & Wilkinson, 2017). Although the argumentative potential of inquiry dialogue is undisputable, especially in the way it was conceived by Walton (1998), considering only one of the several possibilities of engaging in teacher-student argumentative interactions is limiting. In our approach, we consider a range of possible argumentative dialogues, inspired by Walton’s theory, which, we argue they also serve a pedagogical goal through fulfilling pre-defined epistemic criteria. Before presenting the framework, we will present what these epistemic criteria may be from both a “learning-to-argue” and an “arguing-to-learn” perspective.

## 2.2. Epistemic criteria for productive dialogic argumentation

Our review of the literature on dialogic argumentation in science education and in social sciences education has identified several criteria, applicable to both whole-class and small-group discussions, that can lead to successful, productive argumentation dialogues in the classroom. These criteria discussed in this section include a) evidence of epistemic discourse, b) sharing of knowledge and reasoning explicitly during interactions, c) interpretation and co-ordination of theory and evidence, d) increased accountability, e) abductive reasoning, and finally, f) dialectical confrontation.

Argument-based interventions aim at creating opportunities for student collaborative argumentation, as if they were engaged in an authentic argumentative dialogue. When the issue is related to science content, such dialogue needs to resemble epistemic discourse (Christodoulou & Osborne, 2014), defined as a way of talking which models the discourse scientists engage in, as new scientific theories are conceptualised, negotiated and established through construction and critique (Ford, 2008). When the issue is non-science-related, students are usually given specific guidelines of how to create and address their spontaneous or forced disagreements about an issue. Usually, in the first case the main focus is on “arguing-to-learn”, where argumentation is a means for scientific knowledge to be meaningfully constructed and understood by students; and in the second case, the focus is mainly on “learning-to-argue” (Von Aufschaiter et al., 2008) focusing on the acquisition of argumentation skills, such as the construction of valid arguments, the selection of adequate evidence to justify those arguments, the identification and construction of counter-arguments, and the adequate reply to those.

Making knowledge explicit is the starting point of any argumentative interaction. Students are asked to verbalise their own conceptions, which makes them the object of further examination by teachers and students (Asterhan & Schwarz, 2016). This allows both learners to reflect on their own understanding and teachers to get an insight of the learners’ understanding, and thus identify how to address misconceptions, and move this understanding further. As ideas and possible solutions to the problem are discussed, different meanings and concepts are shared. These starting points of discussion have been given different names, such as: warrants, *topoi*, or prior knowledge. However defined, their function is highly important as they give a sense of the first-level explanations that students come up with as they start to engage with the phenomena under discussion. The teacher’s role is then one of guiding this sense-making process (Berland & Reiser, 2009), encouraging students to express ideas and contribute to the common set of knowledge.

Nonetheless, an argument-based pedagogical goal is not one of accumulating different pieces of a puzzle, but of engaging students in the idea of putting those different pieces together in ways that make sense to each other and as a whole. However, the limits between inviting “everyone” to participate in the discussion and avoiding what is known as cumulative talk (Mercer, 1996; Mercer et al., 1999) are not well-defined. This problem has been addressed thus far through concrete teacher invitations for students to make explicit their reasoning, and not only to say what they think or know. When discussing general or moral issues, these invitations may take the form of teachers’ rhetorical moves, when teachers ask students to make specific argument elements explicit (e.g., Chinn & Anderson, 1998). When in science, these teacher moves correspond to concrete prompts for making claims, data and hypotheses explicit (e.g., Erduran et al., 2004; McNeill & Pimentel, 2010).

Interpretation of evidence and its adequate coordination with existing and expressed theories is an important epistemic goal of argumentation (Kuhn, 1993; Duschl & Osborne, 2002; Sandoval & Millwood, 2005; Garcia-Mila & Andersen, 2008). According to Kuhn and colleagues (Kuhn, Zillmer, Crowell, & Zavala, 2013), an evidence-based view of argumentative knowledge construction is well justified. For them, information only becomes evidence when it is functionally integrated in one’s argumentation. Further, Koslowski, Marasia, Chelenza, and Dublin (2008) identified that information only becomes evidence when both the information and the possible explanation can be incorporated into one causal framework. Koslowski et al. (2008) also found that for such coordination of theory and evidence to take place, explicit prompting about the possible relations between theory and evidence is required. Such conclusions support initiatives in teacher education that focus on ways of scaffolding and extending students’ thinking through discursive interactions.

The richer the argumentation dialogue, the more necessary it is to identify who defends what, and therefore, who becomes accountable for which ideas. According to Ford (2008), accountability has an epistemic function, as “sense making becomes scientific sense making when authority is exercised with the *knowing that* and *knowing how* involved in holding knowledge accountable” (p. 417, emphasis in the original). In that sense, accountability is opposed to prescribed authority, and as such students and teachers become equal in their right of contributing ideas, as long as they are well-justified. Teachers are crucial catalysts in this process as they need to make sure that students express reasons in the form of arguments, and that there is consistency in their discourse within the dialogic interaction. Argument-based teaching prompts in this direction is to invite students by their names and to label students’

discursive contributions as argument elements (Reznitskaya & Wilkinson, 2017).

On the basis that scientific knowledge advances through a combination of deductive, inductive, and abductive reasoning processes, it is the epistemic goal of creating (new) knowledge that is per se abductive (Rapanta, 2018, b; Peirce, 1878). When transferred into the classroom, the need for abductive reasoning to emerge, so that authentic science talk may take place, is translated into issues to which the answer is unknown. For instance, students could be given a set of evidence and asked to infer the best possible explanation engaging in this process in critique of different explanations. This becomes problematic when, for example, the teacher sticks to the textbook and (s)he does not allow for “real” scientific issues to emerge. This is because most - if not all - scientific knowledge contained in a textbook is already established by the corresponding scientific community. The role of the teacher becomes then one of transforming accepted knowledge into open issues, and of inviting students to present their own solutions as if they were still unsolved.

Regarding how to frame students' discourse, there is increasing evidence students argue better when the goal is to reach consensus rather than persuade each other (Felton et al., 2015; Nussbaum & Kardash, 2005). It seems that the quality of argumentative reasoning increases when peers are asked to collaborate towards a common idea/solution, rather than to convince others that their idea is better. However, collaborative deliberation still includes elements of a dialectical confrontation (Coffin & O'Halloran, 2009). Albe (2008) compared the dialogic argumentation of two groups of secondary school students exploring a socio-scientific issue (SSI); she found that the argumentative interactions of the two groups developed differently: one group, where students were in disagreement, engaged in collaborative argumentation and co-construction of understanding to a greater extent, compared to the second group, which took a procedural approach to the task. Patterns of interaction in both groups were identified based on acceptance, collaborative argumentation, and contradictory confrontations, which facilitated the communication about the SSI. In whole class interaction, the dialectical element may be present when the teachers explicitly ask students to take a position about a two-sided issue (Dawson & Venville, 2010), or when groups meet together to present the results of their consensus discussions as a way to confront different theories about the same phenomenon (Berland & Reiser, 2009).

### 2.3. Walton's types of argumentation dialogues

Walton (1998, 2008) proposed seven types of argumentation dialogues, which could potentially emerge in an everyday discourse context. In the *eristic* dialogue, or quarrel, the participants' goal is to “defeat and humiliate the other party” (Walton, 1998, p. 33). *Deliberation* dialogue is one in which the agents' goal is “to decide what is the best or the most prudent course of action in a given situation” (ibid, p. 34). In *negotiation* dialogue, the aim of both parties is to “make a deal” (ibid, p. 32). Within a pedagogical frame, eristic dialogue would not be one to expect to find, or indeed to help teachers develop. Deliberation dialogue however might be an aim when students engage in decision-making tasks, for instance within science education when a socio-scientific issues-based education framework is adopted (Zeidler, 2014), or in topics such as civic education, where questions about what should be done about a certain issue, or how students would personally approach an issue might arise (Asterhan & Schwarz, 2016; Felton et al, in this issue). However, here we are interested in whole-class discussions, therefore, any deliberation elements fall within a teacher-guided persuasive dialogue.

The fourth type of dialogue is *information-seeking*, where the “goal is for information to be transmitted from one party to the other” (ibid, p. 31). Then there is *inquiry* dialogue, where “the goal is for the participants to collectively prove some particular proposition (...) or to show that the proposition cannot be proved at the present stage of knowledge” (ibid, p. 32). In *discovery* dialogue, which was originally defined as “chance discovery” by McBurney and Parsons (2001), “the question whose truth is to be determined only emerges during the course of the dialogue itself” (Walton, 2010, p. 19). Last but not least, the goal of a *persuasion* dialogue is “to test the comparative strength or plausibility of arguments on both sides of a controversial or contentious issue” (Walton, 1998, p. 37).

Of these types of argumentation dialogue, the four mentioned above, namely information-seeking, inquiry, discovery and persuasion dialogue, have been recently conceptualised as potential pedagogical practices (Rapanta, 2018, a) that could emerge as part of teacher-student interactions. The aim of this study is to extend this line of research by characterising these four types of dialogue within different types of pedagogical contexts, both in science and social sciences education. To achieve this goal, an operationalisation of types of teacher-student dialogic sequences is proposed, that combines the argument-related epistemic criteria described above with the pragmatic characteristics that define a dialogue promoting an argumentation goal.

### 3. The present study

Within a talk or conversation, different dialogues may emerge; their identification depends on the participants' goals made explicit through their dialogue acts, i.e. individual moves. The tradition in the analysis of argumentation dialogue in different contexts is divided into two main tendencies, which may be described as a “bottom-up” and a “top-down” approach. The former focuses on the pragmatic characteristics of the context in which a dialogue takes place and which imply that participants have certain communication goals to achieve; it is those goals that guide the dialogue and their fulfilment or not depends on participants acts (Levinson, 1992). The latter focuses on the normative characteristics of dialogue, analysed a priori as “rules” or “stages” which must be fulfilled for a dialogue to meet its felicity condition. This may be described as a top-down approach to dialogue analysis (see, for example, Walton & Krabbe, 1995). In this paper, we adopt a “bottom-up” approach to dialogue type definition, therefore it is what actually happens within the dialogue that is used as “evidence” to guide analysts in the definition of its “type”. In this sense, the “dialogue type” is not different than a “goal-oriented dialogue sequence”. Moreover, we are interested in argumentation types of dialogues, meaning sequences somehow leading to the fulfilment of an argumentation goal, which may be generally defined as the

**Table 1**

The four argumentation dialogue types (Rapanta, 2018, a; Walton, 1998, 2010).

Goal	Initial situation	Main goal	Participants' aims	Criteria
Information seeking	Need of shared knowledge	Make background knowledge explicit	Check knowledge Share information Build common ground	Examine previous understanding/knowledge
Inquiry	Need of examining evidence	Find the strongest evidence/ Articulation	Assess/Interpret/Compare evidence Coordinate evidence with claims	Better understanding of evidence Acquiring technical terminology
Discovery	Need of possible explanations of a problem	Find the best hypotheses for testing or analysis	Identify a problem to solve Define problems Choose criteria for testing	Stimulate creativity/curiosity Establish an environment for problem solving
Persuasion	Need of examining alternative explanations/theories/solutions	Find the best explanation/ theory/solution	Persuade others Support explanations with the strongest evidence available	Develop and reveal positions Build up confidence Make a decision

resolution of “something”, this something being: a lack of knowledge, in the case of information-seeking dialogues; a lack of proof, in the case of inquiry dialogues; a new issue, not addressed before, in the case of discovery dialogues; and a disagreement, in the case of persuasion dialogues.

### 3.1. Dataset characterisation and segmentation

The data used in this study were collected through classroom observations from six science and social science secondary school teachers and their students. The dataset consists of ten science lessons, in English, and ten social science lessons, in Portuguese. The science lessons were taught by two of the six teachers, one male and one female, with 20 and 3 years of teaching experience respectively. The four social science teachers (history and civic education) were three female and one male, with all having > 20 years of teaching experience. All teachers were actively taking part in professional development (PD) initiatives focusing on developing more dialogic, and argument-based pedagogies in secondary education at the time of data collection. The PD was based on pedagogical adaptations of the Toulmin Argument Pattern (Erduran et al., 2004; McNeill & Krajcik, 2012) focusing on the use of claims, evidence and reasoning as they emerge within dialogues, in the science case, and on dialogic and argument-based teaching around general issues, in the social science case. Of the 20 lessons, seven science lessons were framed by the teachers as lessons with an explicit arguing-to-learn approach as indicated on Table A1 (see Appendix).

Within a theory-driven bottom-up approach, we used as a starting point the four types of dialogue considered most relevant to emerge in classroom settings within teacher-student interactions, as discussed above (information seeking, inquiry, discovery dialogue, and persuasion dialogue) (Table 1). The objective was to operationalise these types of dialogue into classroom discourse sequences, identify how such types of dialogue appear in teacher-student interactions and how (and whether) these are taken up by students, or teachers, in the case of student-initiated dialogues.

### 3.2. Data analysis

The first stage of the data analysis process was segmentation. The dataset was segmented in: a) dialogue acts; and b) dialogue sequences. Dialogue acts are defined as minimum self-coherent units of dialogic interaction, meaning segments of discourse, possibly of the same participant's utterance, that express an independent dialogical intention (e.g. asking a question) (Macagno & Bigi, 2017). Segmentation is based on the simple rule that a dialogue move must express a different dialogical intention than the subsequent move. Difference is defined either by intention type (e.g. to explain, to clarify, to invite contributions, etc.) or by the object of the intention (e.g. to explain “a” versus to explain “b”). Similarly, dialogue sequences are separated either based on their self-coherent dialogue goal (e.g., inquiry), or as their thematic focus (Schegloff, 2007). Discourse not based on teacher-student interactions (e.g. student group discussions) was not considered.

The second stage of the analysis involved both authors jointly coding lesson transcripts as a data familiarisation technique (Braun & Clarke, 2006), as well as a means of developing and establishing a shared understanding and working definitions of the key dialogue types applied to the data. Fig. A1 in the Appendix provides the decision tree that emerged at this stage. The analysis took the form of an iterative process of identifying sequences where particular types of dialogues were initiated either by the teacher or students, and it was open enough to allow for new categories to emerge where necessary. A subset of lessons (20%) was chosen for inter-rater reliability testing. Each researcher coded independently all lessons in this subset based on the final framework produced, and comparisons were made. Inter-rater reliability reached a good standard (83.4% agreement; Cohen's Kappa: 0.796), with all discrepancies identified, discussed and resolved.

## 4. Findings

The final dataset consists of 570 dialogue sequences composed of 7658 lines (dialogue acts). The nature of the teacher-student



interactions examined took the form of three different types of sequences, namely argumentative, argumentative affordances, and other, with a total of 12 sub-types. Fig. 1 presents a summary of the main goal and expression of each one of the dialogue sequence sub-types identified in the dataset.

Fig. A2 in the Appendix presents the frequencies for each type and sub-type. Of the total number of sequences, 274 (48%) belonged to one of the argumentative dialogue types, 59 (10%) represented argumentative affordances, and 237 (42%) were of other types. Within the first type, IS was the most common category (29%) followed by IN (14%); within affordances, IN affordances was slightly higher in frequency than IS affordances (5% and 4% correspondingly); among “Other” sequences, “procedural” was the highest (31%), with “meta-dialogue”, “monologue”, and “off-task” following. Below we provide explanations and examples for each type of dialogue sequence identified.

#### 4.1. Argumentative dialogue sequences

Among the four argumentative dialogue sequences, IS (29%) was mostly dominated by the teacher, by either checking students' knowledge, as a type of a cross-examination dialogue, or establishing common ground through the contribution of knowledge, clarifications and elaborations. For instance, in Table 2, the teacher's goal is to ensure that the students have a clear understanding of the key scientific concepts required to complete the task (i.e., explain how weight changes on different planets). From an epistemic point of view, the goal is not to construct new knowledge, but to make prior knowledge explicit so as to understand each other. When the IS dialogue is teacher-initiated, it is a typical series of IRF (Initiation-Response-Feedback) exchanges (Sinclair & Coulthard, 1975), meaning that the teacher gives superficial feedback to the student through a correct/wrong evaluation of the answer (line 171) or an invitation for other students to comment on it.

We found that IS sequences resemble cumulative talk (Mercer, 1996), where the goal is to share ideas without a further evaluation or critique of those ideas. It can also resemble a pseudo-brainstorming where several students share their opinions about something without any invitation from the teacher for further reflection or elaboration. Finally, IS sequences may also be that the teacher asks for a superficial reason for these opinions that still remain at a “claim-data” level, with no evidence or reasoning expressed or invited. We identified that IS sequences could be student-initiated, usually when the student has not understood well a concept and asks for a clarification, definition, or explanation from the teacher, who replies as the only “owner” of this knowledge without opening the dialogue space for further exploration or reflection. IS sequences initiated by students could be confirmatory (see Table 3).

Inquiry (IN) dialogic sequences resemble exploratory talk (Mercer, 1996), with a gradually acquired sense of accountability, translated into commitment and sense of ownership towards the ideas expressed. If in IS the importance is on making knowledge and/or ideas explicit, in IN the focus is on the justification for the expressed ideas. The teacher not only asks about students' opinions, interpretations, or hypotheses but (s)he encourages them to reason about them, articulate their knowledge with their arguments, and/or coordinate their theories with evidence. This evidence may also emerge from peers' contributions, so transactive statements between students are possible and welcome to appear. Students do not only say whether they agree or disagree with the teacher or other students, but they also say why. The weight is on the justification part of argument and on the co-construction of knowledge, whenever this is possible. Table 4 provides an example of a teacher-initiated IN dialogue sequence.

Discovery (DS) dialogue sequences aim at pointing out at a new problem or aspects of the issue at hand and present them as topics of investigation, opening up the space of reflection. This is mainly done through inviting analogies or transfer of reasoning to everyday situations or through observing interesting aspects of a phenomenon and trying to establish connections between those aspects and a solution, but without arriving at a solution. If IS is about search for information and IN is about search for evidence, DS focuses on the search of a problem, by coming up with an issue for investigation and establishing criteria for it. When initiated by the teacher, it is about opening up the dialogue to issues not included in the teacher's plans, that make students think further, and which certainly increase the aporetic element of the discussion (Rapanta, 2018, a). Table 5 shows an example of a DS dialogue sequence initiated by a student.

Although in DS dialogues it is possible that some main explanations of an issue are discussed, there is no discussion about deciding on the best explanation. Evidence is used to support the relationships between data and claims but not for comparing different arguments. It is this dialectical confrontation between ideas, manifested through counter-arguments and rebuttals, which forms an exclusive part of a persuasion (PE) dialogic sequence. This can either be manifested as the optimum of abductive reasoning, in which different existing theories are contrasted on the basis of their justificatory power for a specific phenomenon, or as a whole class deliberation, in which the teacher guides students through their defence of an option “a” as being better (more justified with evidence) than option “b”. This search for the best explanation, which is the core of abductive reasoning (Peirce, 1878), is the main goal of PE sequences. Table 6 shows an example of a PE dialogue sequence initiated by the teacher.

#### 4.2. Argumentative dialogue affordances

An interesting type of dialogue sequences that emerged from our analysis is one that we called *affordance* of argumentative dialogue to distinguish it from the *fulfilled* argumentative dialogue. Each one of the four types of argumentation dialogue, discussed in the previous section, was also manifested as an affordance type, in the following ways:

1. In IS affordance dialogues, there is only slight evidence of the need to share knowledge, and the goal of making background knowledge explicit is not fulfilled;
2. In IN affordance dialogues, there is a slight evidence of the need to examine/understand evidence, and the goal of coordinating

<b>Information-seeking dialogue sequence (IS)</b>
<ul style="list-style-type: none"> <li>● Goal: To make sense of information, to understand each other.</li> <li>● Expression: It may vary from a cross-examination dialogue of checking knowledge to a sequence of trying to understand a given concept based on clarifications.</li> </ul>
<b>Inquiry dialogue sequence (IN)</b>
<ul style="list-style-type: none"> <li>● Goal: To articulate theory with evidence.</li> <li>● Expression: It may vary from a simple exploration of an issue in the form of guided brainstorming or exploratory talk to a more open examination and interpretation of variables related to the issue.</li> </ul>
<b>Discovery dialogue sequence (DS)</b>
<ul style="list-style-type: none"> <li>● Goal: To place focus on a new issue or manifestation of an issue.</li> <li>● Expression: It may vary from a sequence where students come up with/define the problem to look at to a sequence in which they transfer knowledge to a new context.</li> </ul>
<b>Persuasion dialogue sequence (PE)</b>
<ul style="list-style-type: none"> <li>● Goal: To persuade others about the truth or more scientific value of a theory/explanation over another.</li> <li>● Expression: It may vary from a less structured sequence where the focus is placed on justification and replying to alternatives to a more structured one where students are explicitly asked to take one position or another and to defend it.</li> </ul>
<b>Information-seeking affordance sequence (IS aff)</b>
<ul style="list-style-type: none"> <li>● Goal: The goal of making background knowledge explicit is not fulfilled.</li> <li>● Expression: There is slight evidence of the need to share knowledge.</li> </ul>
<b>Inquiry affordance sequence (IN aff)</b>
<ul style="list-style-type: none"> <li>● Goal: The goal of co-ordinating theory with evidence is not fulfilled.</li> <li>● Expression: There is slight evidence of the need to examine/understand evidence.</li> </ul>
<b>Discovery affordance sequence (DS aff)</b>
<ul style="list-style-type: none"> <li>● Goal: The goal of identifying hypotheses or new data for analysis is not fulfilled.</li> <li>● Expression: There is slight evidence of identifying a new (manifestation of a) problem.</li> </ul>
<b>Persuasion affordance sequence (PE aff)</b>
<ul style="list-style-type: none"> <li>● Goal: The goal of comparing between different explanations is not fulfilled.</li> <li>● Expression: There is slight evidence of the need to compare alternative explanations or theories.</li> </ul>
<b>Procedural sequence (proc)</b>
<ul style="list-style-type: none"> <li>● Goal: To coordinate procedures (e.g. activities, lesson structure, etc.)</li> <li>● Expression: Task and/or talk regulation.</li> </ul>
<b>Meta-dialogue (meta)</b>
<ul style="list-style-type: none"> <li>● Goal: To reflect on the dialogue itself.</li> <li>● Expression: Self or group evaluation or metacognitive reflection on purposes, processes, values, and/or outcomes of learning or activity.</li> </ul>
<b>Monologue (mono)</b>
<ul style="list-style-type: none"> <li>● Goal: To expose knowledge or explanation.</li> <li>● Expression: It is usually expressed as recitation.</li> </ul>
<b>Off-task</b>
<ul style="list-style-type: none"> <li>● Goal: No specific goal is expressed.</li> <li>● Expression: It is manifested as irrelevant to the main task interaction.</li> </ul>

**Fig. 1.** Types and sub-types of dialogue sequences identified in the dataset.**Table 2**

An example of an IS sequence in Lesson 5 (Teacher A).

Line	Sp.	Transcript
167	Teacher	Right, can you link mass, gravity and weight together for me?
168	Stud1	What?
169	Teacher	Can you link mass gravity and weight together for me?
170	Stud2	Yes. The weight is the, no wait...the mass is the matter, is the matter of an object, the gravity pulls the mass down that creates the weight.
171	Teacher	Brilliant. So, mass is affected by gravity and that creates weight.
172	Stud3	Yeah.
173	Teacher	And the more gravity there is the more weight will be produced. OK. So use those ideas, use those ideas, yeah?
174	Stud2	Mass times gravity is weight.
175	Teacher	There you go. It's a mathematical way of expressing the same thing.

**Table 3**

IS sequence initiated by a student during Lesson 8.

Line	Speaker	Transcript
156	Stud1	Miss what is that thing that keeps moving (on the screen)?
157	Teacher	Blue thing that keeps moving?
158	Stud1	Like dark blue.
159	Stud2	Seaweed.
160	Teacher	Where? That's just to show that the water's moving, so you've got a deeper ocean there than you have over there.

**Table 4**

IN sequence initiated by Teacher B in Lesson 2.

Line	Speaker	Transcript
183	Teacher	Did you argue it out?
184	Stud1	Yeah.
185	Stud2	Yeah but Miss is it 100% accurate yeah? When you have cells removed, could it effect their future or whatever?
186	Teacher	Possibly, we don't know.
187	Stud3	But it said on the last video that,
188	Stud2	She said that on the video,
189	Stud3	It said on the video that 100% not affected.
190	Teacher	Yeah, so far everything they have carried on so far it hasn't affected them but,
191	Stud2	It's inaccurate.
192	Stud3	She said they are affected and I said that it hardly do anything, it won't hurt really.
193	Teacher	Yeah, you kind of, the evidence so far have shown that it's fine, it doesn't hurt them but we never know, things can always go wrong.
194	Stud3	So is both right?
195	Teacher	Yeah, kind of.

**Table 5**

DS sequence initiated by a student during Lesson 6.

Line	Speaker	Transcript
436	Stud1	Miss, wouldn't that really make it the, right, if you had a clone yeah, wouldn't it really make it your mum's and dad's baby cause it's part of their genes anyway?
437	Teacher	So if there was a clone of me, yeah,
438	Stud1	Yeah, with your genes,
439	Teacher	Yeah, it would be my clone it wouldn't be my parents clone.
440	Stud2	Cause only half of her parents are a clone of her.
441	Teacher	Cause a clone has identical genes, so if I clone myself, my clone is going to have identical genes to me but it's going to have half of my mums and half of my dad's. So it won't be identical to them.
442	Stud1	But won't it be identical with their genes?
443	Teacher	Yeah, it would be their, it would be,
444	Stud1	Like their kid.
445	Teacher	Yeah. Well not technically because they didn't give birth to it, it's a bit complicated.
446	Stud2	Miss, if you had to clone your own child unnaturally then it would be like, their genes would be a quarter of each grandparent.
447	Teacher	That's it, yeah.



**Table 6**

PE sequence initiated by Teacher B during Lesson 7.

Line	Speaker	Transcript
153	Teacher	Right, so you're for and you're against. OK. So what S1 just said to you?
154	Stud2	Nothing. She's not to start.
155	Teacher	Right, so who's starting?
156	Stud2&3	Us.
157	Stud1	They are going with against.
158	Teacher	Alright then, go on, so why is it wrong?
159	Stud2	No, we're not talking about...
160	Stud3	It is wrong because that would mean that the doctors can cause defects to the child that doesn't even have cystic fibrosis.
161	Teacher	Yeah so you,
162	Stud2	Because they are missing embryos from,
163	Teacher	Cells. Yeah, so they are taking cells from the embryo, so they don't know what effect that could have later on in life.
164	Teacher	How are you going to reply to that?
165	Stud4	Ehm,
166	Stud3	They can't.
167	Stud5	No, because they won't know unless they try. So like even if the kid has one little batch of skin that it's like different, it's better than having cystic fibrosis.
168	Teacher	Good.

theory with evidence is not fulfilled;

3. In DS affordance dialogues, there is a slight evidence of identifying a new (manifestation of a) problem, and the goal of identifying hypotheses or new data for analysis is not fulfilled; finally,
4. In PE affordance dialogues, there is a slight evidence of the need to compare alternative explanations or theories, and the goal of comparing between different explanations is not fulfilled.

Extending the above, IS affordance dialogues are more monological than IS dialogues. An example of IS affordance dialogue is when students are asked to read aloud from the textbook and the teacher stops them and comments on what is read. It is an affordance, because not an actual dialogue is taking place. IN affordance dialogues tend to “fail” to be authentic inquiry, either because the teacher does not leave space for students' reasoning, or the students do not arrive at giving support for their ideas due to, for example, lack of sufficient prior knowledge. A dialogue is marked as DS affordance instead of DS when a question or comment, by either the teacher or a student, implies the introduction of a new issue or the manifestation of an issue previously discussed, but with no genuine exploration of it. Finally, in a PE affordance dialogue, the teacher invites students to compare two contrasting theories, but comparison is not continued. Fig. A3 in the Appendix shows a representative example of each type of affordance dialogue.

#### 4.3. Other dialogue sequences

Under the type “other”, the following four categories emerged: (a) procedural talk, i.e. any instance/sequence where (usually) the teacher will provide explanation that focuses on how to do a task, or that focuses on classroom organisation and management issues (e.g. telling students where to sit, where to move to, etc.); (b) meta-dialogue sequences, based on Hennessy et al. (2016) “reflect on dialogue or activity” category, which they define as “explicit self or group evaluation or metacognitive reflection on purposes/processes/value/outcome of learning or activity; engaging in talk about talk/protocol for dialogue; an invitation to engage in any of the above” (p. 21); (c) monologue, when teachers give a long monological explanation without any invitation to students to engage; and (d) off-task, when the dialogic sequence focuses on topics or activities different to the lesson's focus. Fig. A4 in the Appendix shows a representative example of each.

There were various instances where teachers engaged in a monological sequence. Following our sequence segmentation rules a monologue was distinguished from a long utterance when a new goal and/or topic was introduced and followed by one participant only, who was always the teacher. This was expected to occur as explanation is often expressed as expository talk. However, distinguishing a monologue from a non-interactive dialogic sequence (Scott, Mortimer, & Aguiar, 2006) was not always easy. In this regard, we marked a sequence as monological when there was not a minimum active or genuine participation from the students' part. In cases where participation was present but maintained to a minimum level of interaction with the contents exposed, the sequences were marked as information-seeking affordances.

## 5. Discussion

The aim of this study was to operationalise an existing framework of argumentation dialogue types proposed by Walton (1998, 2008) into dialogic sequences which actually emerge in a context of genuine teacher-student interactions. To do so we have identified criteria of good classroom argumentation within learning-to-argue and arguing-to-learn approaches and have considered how these criteria can be achieved by different types of argumentation dialogues. When applying the argumentation dialogue framework to teacher-student interactions taking place within naturalistic classroom settings, we found that all four types of Walton's argumentation dialogue previously identified as having pedagogical potential (Rapanta, 2018, a) emerge as argumentative dialogue

sequences in practice.

We also found that within teacher-student dialogic sequences, affordances were being created either by students or by teachers for engaging in particular types of dialogue, which were not subsequently fulfilled as a goal, and which we labelled as argumentative affordances. The identification of affordances for particular types of dialogue contributes to the field by offering an insight and examination of dialogic potentiality within teacher-student interactions, and points to the significance that the initiator of the dialogic sequence has in impeding or facilitating the development of productive discourse. The unfulfillment of the pretended communication goal mainly takes place either because of lack of engagement of students in teacher's dialogic efforts, or because of teacher's choice not to address a student's dialogic move which shifts the goal of the dialogue. The phenomenon of 'contradictions of agency' has been studied before, but in terms of students opposing instructional initiatives of contents, procedures, or tasks (Rajala, Kumpulainen, Rainio, Hilppö, & Lipponen, 2016). Following a dialogue operationalisation approach, this paper proposes a different type of opposition, one in which a party in the dialogue, either the teacher or a student, introduces a new frame which is neglected or not sufficiently followed by the other party. Therefore, the dialogue remains at an "affordance" level, not reaching its ultimate communication goal.

As expected, teacher-initiated sequences were more frequent in classroom discourse than student-initiated sequences. More importantly, student-initiated sequences were often manifested in exchanges only at the affordance level. We consider this issue in relation to what we identify as dialogic potentiality, which can facilitate the manifestation of relevance for argumentative dialogues at two levels; first at the level of dialogue type, and second at the level of content. At the level of content, it might be that teachers do acknowledge the dialogic potentiality and relevance of students' contributions, but it is simply not within the pedagogical goals and learning objectives set for their lessons, and they thus choose to either ignore such contributions, or suggest that such contributions will be picked on and unpacked at a later point, and thus left unfulfilled. Particularly relevant at this level is the presence and take up of discovery dialogue or affordances by teachers and students. Discovery dialogue sequences require the identification of a new issue to be examined, or the application of existing information to a new context. If the latter is the case, then it is more likely that the argumentative goal will be fulfilled (Table 1), as this might provide an opportunity for the teacher to engage students in sense-making and articulation of ideas (Berland & Reiser, 2009). If the former is the case, this might often be manifested in a way that is beyond what the teacher considers to be the scope of the lesson, especially when it is a student-initiated discovery dialogue sequence.

At the dialogue type level, the emergence of student-initiated affordances for a particular type of dialogue could be attributed to the fact that teachers were not able to acknowledge and recognise the dialogic potentiality of students' contributions for the development of a particular argumentative dialogue sequence, and were therefore left with an unaccomplished dialogical goal instead of transforming the affordance presented in a student's contribution into an argumentative dialogue sequence. Recognising the dialogic potentiality of students' contributions and affordances is crucial in shifting the nature of the sequence from one level to another. For instance, if within an IS sequence, a student contribution provides affordances for engaging in inquiry by engaging in an examination of evidence provided by the teacher, the teacher needs to be in a position to first identify the potential of such contribution and second, to use the student's contribution to shift the nature of the dialogic interaction and to engage in argumentative dialogue of a potentially higher level. However, moving from one type of dialogue to one that is at a higher level in terms of challenge and argumentative potential (e.g. from IS to IN), means more uncertainty and less authority for the teacher who would need to open up the dialogue space. For this to be achieved within everyday classroom settings, the dialogic accountability and commitment of both teachers and students also needs to be examined.

Within the limitations of the dataset from which the classroom discourse sequences framework presented in this study was developed, we have identified ways in which teachers can increase the argumentative potential of their discursive interactions with students. Identifying the type of argumentation dialogue teachers are engaging in or affordances offered by students during this process can transform everyday classroom talk into productive discourse. Further research in the ways in which teachers move from one sequence type to another, as well as how dialogic accountability and potentiality can be fulfilled can inform both in-service and pre-service teacher education programmes aiming at establishing productive forms of discourse in classroom settings.

### Declaration of competing interest

No potential conflict of interest was reported by the authors.

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## Appendix A. Appendix

Table A1

A summary of the study's dataset.

Teacher information	Lesson details
Teacher A – Science (English; 13–14 year old students)	Lesson 1 – Smoking (401 lines) Lesson 2 (Arg) – Should pesticides be used? (538 lines) Lesson 3 (Arg) Photosynthesis (655 lines) Lesson 4 (Arg)- Forces - (509 lines) Lesson 5 (Arg) – Gravity on other planets (354 lines)
Teacher B – Science (English; 14–15 year old students)	Lesson 6 – Cloning (491 lines) Lesson 7 (Arg)– Embryo selection (366 lines) Lesson 8 – Plate tectonics (478 lines) Lesson 9 (Arg) – Acid Raid (511 lines) Lesson 10 - Antibiotic investigation (521 lines)
Teacher C – Civic Education (Portuguese; 12–13 year old students)	Lessons 1 & 2 – Students' rights (452 lines) Lessons 3 & 4 – Students' obligations (409 lines)
Teacher D – History (Portuguese; 13–14 year old students)	Lesson 5 – New World's economy (291 lines) Lesson 6 – Portuguese discoveries (325 lines)
Teacher E – History (Portuguese; 14–15 year old students)	Lesson 7 – End of World War I (497 lines)
Teacher F – History (Portuguese; 14–15 year old students)	Lesson 8 – Russia's panorama in the beginning of the 20th century (398 lines) Lesson 9 – Social and artistic revolutions in the beginning of the 20th century (299 lines) Lesson 10 – Soviet revolution (163 lines)

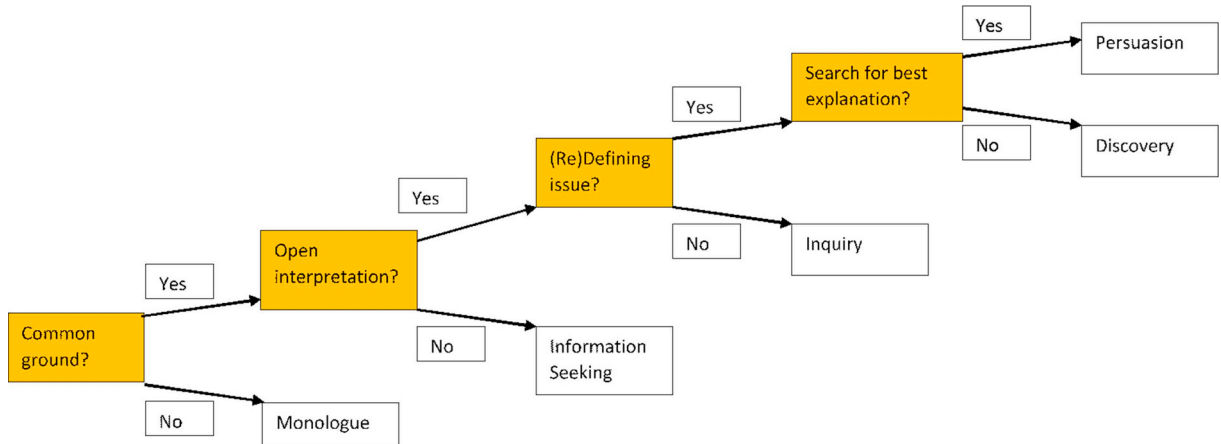


Fig. A1. The decision tree explaining the distinctions between the four main types of argumentation dialogue types.

Type	Number	% total (N=570)	Length
<i>1. Argumentative dialogue sequences</i>			
<b>IS</b>	166	<b>29%</b>	2563
<b>IN</b>	82	<b>14%</b>	1881
<b>PE</b>	18	3%	276
<b>DS</b>	8	1%	159
<i>2. Argumentative affordances</i>			
<b>IN aff</b>	28	<b>5%</b>	444
<b>IS aff</b>	20	<b>4%</b>	185
<b>DS aff</b>	5	1%	51
<b>PE aff</b>	6	1%	59
<i>3. Other sequences</i>			
<b>proc</b>	174	<b>31%</b>	2916
<b>meta</b>	28	5%	300
<b>mono</b>	19	3%	185
<b>off task</b>	16	3%	168

**Fig. A2.** Frequencies and types of sequences and sequence initiators, i.e. either teacher or student, emerged in the dataset (in bold the highest relative percentages).

**IS affordance (student-initiated)**

S: *Miss, what happens if there's a shortage of enzymes in the liver?*

T: Right, I'm going to talk about that in a moment ok?

**IN affordance (teacher-initiated)**

T: Now, we have this organization here that maintains the peace in the world, we saw before those images, so let's evaluate the action of this organization

T: Was it efficient or not?

S: *No*

T: And what do you think? No, why? From what you people know. Gary?

S: *Because there was a new war.*

T: Because there was a new war, exactly.

**DS affordance (student-initiated)**

S: *How do they know that, what they had to make, do they like put some other people...?*

T: Right. They did lots of experiments in laboratories, they also started by sending dogs and monkeys into space.

**PE affordance (teacher-initiated)**

T: Now in an organised way, thinking together, which one of the two proposals that we analysed here created deeper disruptions in the Russian society? (.) what do you think?

T: Say, Andre, which one seems to you that created deeper alterations?

S1: *The Burguesian revolution because it created the end of the Czarism and of the War.*

T: Yes but not of the War

T: The Burguesian revolution, everyone agrees that it was the Burguesian revolution that came?

S2: *No.*

T: Calm down, say Miguel.

S2: *I think it was the Sovietic*

S2: *because I think that it is the one that changes the government structure the most, [] which is where [] the power of the workers to impose a socialist society..*

T: Yes but why do you think it creates more alterations?

S2: *A society without classes, a []*

**Fig. A3.** Examples of “affordances” types of dialogue.



<b>Procedural (student-initiated)</b>	
S:	[goes to his desk] Sir, can I take one, cause I don't have one?
T:	Yeah.
T:	[to whole class] Without talking.
T:	Maryam, there's always a nice textbook waiting for you if that's what you prefer. Don't look at me look at the text you've being asked to look at.
<b>Meta (teacher-initiated)</b>	
T:	Right, I'm a bit disappointed Year 10, because a lot of you have just sat there, and because it's a sunny nice day outside and the football is on soon, we don't, we don't really want to use our brains to think.
T:	[students talk] Right, shhh. Sh, guys, excuse me... We haven't got many lessons left before you go on work experience and we need to get B2 finished.
S:	Finished?
T:	Yeah.
<b>Off-task (teacher-initiated)</b>	
T:	So to answer all your questions this is a microphone, I'm not any louder because it's just picking up the sound for the camera, so it's just recording the audio, it's not making me louder it's not an amplifier.
S:	Is it on right now?
T:	Yes it is on right now, yes [student start talking].
<b>Monologue (teacher-initiated)</b>	
T:	Right so I'm not too worried if you haven't got the in entirely the right place but what I do want to make sure is that you've got the difference between those two middle columns clear.
T:	So the evidence for recovering should be the ones that say that mosses and plants have returned, ok, dragonfly larvae have returned.
T:	The reason should be to do with the amount of, Charlie, the amount of pollution we've cut. OK?
T:	So can you just make sure that you've got those two columns clear?

Fig. A4. Examples of “other” types of dialogue.

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