Chapter 4
Argumentation Skills for the Design of Formative Assessment Queries

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ABSTRACT

This chapter surveys the benefits of critical and argument skills in bilingual pre-service teachers' future careers for assessment pursuits. It also examines how informal logic for pedagogical purposes is scarcely considered in education settings – both primary and university levels. Yet, such a lack of teacher training will negatively influence subsequent feedback and ad hoc formative assessments to measure bilingual pupils' knowledge accurately. Hence, taking as referents argumentation and critical thinking and enquiring, the chapter aims to establish the fundamental theoretical foundations for understanding and designing formative queries.

INTRODUCTION

Through this *review* study, we aim at interpreting Walton's theory and link it to the education field as argumentation skills for the design of formative assessment queries by Spanish bilingual pre-service teachers. In this regard, there is stated research to observe the influence of metacognition, meta-strategy, and epistemology on the argumentative competence where, from a practical perspective, the results pointed out towards a need for more empirical research on teaching and learning interactions to promote argumentation skills in both trainers and trainees (Rapanta et al., 2013). Since in –science– bilingual classrooms argumentation contributes to fostering literacy and cognition in learners (Aragón, 2007;

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Archila, 2013), especially for pre-service teachers aspiring to teach at bilingual schools, developing argument skills during their training period *might* represent a useful feedback tool in their future careers. The reason is that teachers need to conduct classroom discussions in a continuous fashion for further purposes (Kuhn, 2008). Apart from specific teacher training, bilingual education is experimenting relevant changes, and the transposition of monolingual (L1) didactic methodologies and teaching strategies to foreign language (L2) environments have fallen into disuse –leading to more specific and adapted Content and Language Integrated Learning (CLIL) approaches (Pérez, 2014). Also, because schoolchildren respond differently to external variability and stimuli (Dörnyei, 2005), in-service teachers' daily acts of enquiry-based verbal feedback towards primary education students *might* have different effects on them if similar propositional contents reveal dissimilar illocutionary forces. For example, "'You will leave the room', can be used in different utterances, such as 'Leave the room!', or 'You will leave the room', or 'Will you leave the room?', having different illocutionary forces'" (Macagno & Walton, 2014, p. 129). Since argumentation is influenced by each speaker's rhetorical competence and how it fits the audience it is aimed at (Walton, 2008a), awareness of assertive, directive, commissive, permissive, prohibitive, and declarative speech acts are relevant in the education field. Hence, to ascertain the accuracy level of speech acts and argumentation, self speech and arguments should be dialectically measured in terms of pragmatic and contextual functionality (Walton, 2005a). Yet argument analysis and assessment are considered here the first steps for a more accurate design of formative assessment queries later to be enquired to bilingual primary students.

Since –in primary education– the new learning commonly begins and is prompted through enquiries (Novak, 1998/2010), the instructional models based on the guided *verbal* encouragement of the manifestations of the natural curiosity of pupils would lead them to higher intellectual understanding than models based on the rote learning of contents (Ausubel, 1962; Ausubel, 1963; Ausubel, 1968; Ausubel, 1969; Ausubel, 1977; Ausubel, 2000; Ausubel, 2002; Ausubel et al., 1983). Hence, the curricular 'Content must be viewed within the complex set of variables that contribute to creativity' based on the encouragement of students' thinking skills, self-interests, and mastering of knowledge (Rubenstein, 2000, p. 12). In this sense, when students do not understand the curricular information being managed, the tendency is the memorisation of it (rote learning); contrarily, when students are capable of consciously link non-arbitrarily the concepts or ideas –e.g., throughout critical enquiring– they will be far more prone to acquire substantive and meaningful learning (Ausubel, 1969). When designing critical questions, it is necessary to be aware that those critical questions might probably lead to new critical subquestions –an argument is *closed* when the base critical questions are proved and appropriately been answered (Walton, 2006c). For example, in an argument from ignorance, a critical question designed to get awareness on the in-depth knowledge matching a given argumentation scheme would be 'How far along has the search for evidence progressed?' (Walton, 2006d, p. 365), where the critical question serves as feedback support for the completion of the information not yet been collected by students. Thus, notwithstanding there is abundant bibliography concerning teacher training on traditional formative assessment, to date, there is scarce research on the correlation between the effect of informal logic pre-service/in-service teacher training and its influence in the design of day-to-day appraisals –also querying assessments *for* learning– from the philosophical perspective.

Considering the earlier research suggestions, and as a first step for the promotion of argumentation skills based on Walton's theory, this study aims to present a theoretical approach on relevant aspects of informal logic as the fundaments for the subsequent comparison on arguments, critical thinking skills, and enquiring in bilingual and monolingual pre-service teachers and the way they design accurate and

conscious formative assessment queries. Because CLIL approaches require the specific training of in-service teachers on linguistic, methodological, and assessment areas (D.O.C.M. 2018, 27), both adequate argumentation and enquiring skills are necessary for arguments to be given widener credibility and speakers (e.g., teachers) to be perceived as good characters (Walton 1998a). Hence, critical argumentation skills should be learnt via the examples of arguments that people encounter in real quotidian situations (Walton, 2006a) –so that students perceive teachers as valuable characters and referents. To prompt assessment *for* learning competencies in pre-service teachers, we believe that awareness and training about concepts, propositions, self-assessment of arguments, fallacies, and informal inquiring should form part of contemporary teacher training syllabuses in the education field. In this sense, current and inspiring research about the interactions emerged in regular classroom environments between teachers, students, and the argumentative interactions between them (Rapanta & Christodoulou, 2019; Rapanta, 2018; Rapanta et al., 2013). In this regard, to Walton (1987a, p. 321), there is a need for not only do academic research on formal structures, 'but to teach logic as a criterion for correct argument that is applicable to arguments in domains other than the purely mathematical.' Notwithstanding the problem of scholarly research, Walton points out towards the necessity of broadening the *pedagogical* scope of informal logic. For example, to Resnick et al. (1993, p. 348), 'the structure of the discourse of reasoning depends significantly on the nature of the situation in which that reasoning is carried out [. . .], the goal adopted by the group for the conversation [. . .], the content of the conversation, the kind of physical displays (e.g., objects, pictures, *graphs* [emphasis added], and texts) available, who can see these displays, and who can manipulate them.' In sum, considering the applicable and practical perspective of informal logic, Walton (1987a) recommends taking more seriously the field of pragmatics.

LOGIC

In general terms, *logic* is a science dealing with arguments –where *formal logic* focuses on valid and invalid patterns of arguments and *informal logic* approaches to arguments from the linguistic-pragmatic perspective occurring in natural settings (pragmatics of discourse). To Woods et al. (2004), logic manifests a global orientation aiming at revealing universal truths about rational arguments through the study of argument forms. In other words, in a given proposition, the logical structure of it would differ from the grammatical form in that the first one focuses on the effectiveness and the *logic* of the propositional argument; while the grammatical form concentrates on the *structure* of it. The argumentation study has traditionally been linked to formal logic, which is 'the science of reasoning that studies *formal* [emphasis added] inferential links between sets of propositions designated as premises and conclusion of an argument' (Walton, 2007a, p. 7). In the history of logic, a prime *material logic* not so focused on the form of reasoning would end 'into the science of deductive logic, which, in the twentieth century, became mathematical logic' (Walton, 2007a, p. 7). As it happens with propositional and grammatical arguments, ordinary acts of thinking not necessarily involve rationality –being the foremost psychologically based and the ulterior more logically influenced. As it happens to humans, daily acts of speech are unique to every person, and the pragmatic skills required for arguments identification encompass techniques to be *consciously* acquired (Walton, 2008a, Walton, 2008c). Though daily acts of speech are unique to every person, in a conversational analysis Resnick et al. (1993) observed that, when participants listen to each other actively, logical arguments tend to be constructed 'in relation to what others say' (p. 362).

The roots of informal logic emerge from the interpretation that formal methods, like deductive logic, were not as efficient as they were expected to be in the study of naturally executed arguments (Walton, 2015a). To Walton (1988), informal logic –or practical logic– focuses on how arguments are used in specific contexts. In natural environments (e.g., classroom), the interaction between conversational peers prompt in them self-awareness and beliefs (Amigues, 1988). In other words, informal logic makes interpretations of the propositional uses of speech acts in numerous dialogical settings (Walton, 1990). Such an applied logic reveals itself academically convenient because it provides practical information on arguments from the individual perspective. Hence, it could be said that informal logic is inductive in the way that it contemplates arguments as particular uses of language in specific settings: context, characteristics, tasks performance, et cetera. From an opposing viewpoint Walton (1988) argues that, because of the insufficiency on standard goals and well-established frameworks for the evaluation of arguments, informal logic has not thrived as a scholarly discipline. Also, though 'Most efforts to teach informal logic have focused on college-level courses [. . .] organized "programs" at this level are uncommon' (Resnick, 1987, p. 30). Other objection to informal logic as a discipline deals with the specificity of the studied context and field, where 'a principle of [a studied] argument may be correct in one field but incorrect in another' (Walton, 1987a, p. 302). Be that as it may, both informal logic and argumentation are turning into growing phenomena influencing the way logic is currently taught (Walton, 1990). To Reed et al. (2007), fascinating and revealing advances in argumentation come from an ongoing tendency based in the use of computerised models –and argumentation schemes are of interest for researchers focused on artificial intelligence and argumentation (Reed & Norman, 2003; Verheij, 2003, as cited in Walton et al., 2008b).

Apropos of the information above, informal logic studies the particular arguments occurring in specific settings as the logic of the reasoned argumentation of language in its practical or applied form (Walton, 2008b). Therefore, argumentation represents a critical skill to be acquired for its use in everyday situations (Walton, 2013a). Although informal logic considers arguments as they happen naturally in different contexts, the scientific approach to argumentation in the classroom settings is of more difficult performance (Berland & Reiser, 2011). Thus, being able to identify the critical junctures where dialogues become unreasonable, 'and deal with them by asking the *right* [emphasis added] critical questions, are the key skills of informal logic as a discipline' (Walton, 2008b, p. 35). In this sense, to engage students in scientific enquiring, in education there exist approaches like process skills, hands-on curricula, discovery learning, or inquiry-based instruction (Chiappetta & Koballa, 2002). Since most educational settings in argumentation involve series of question-answer dialogues, argumentation reveals itself as the manifestation of 'reasoning in the context of ill-structured, controversial, and debatable problems that may possess multiple, plausible solutions and be viewed from a variety of perspectives' (Sadler, 2006, p. 325). Examples on lack of critical enquiring in arguments occurring in educational settings are when learners are taught the content in-depth but not the logical techniques to reflect, critically think, and argument about a learned product. This is what Kuhn (1992) describes as *rhetorical* arguments, because the instructor just acts as a mere narrator or persuader. To Norris (1997), in real or pragmatic conversations, it is disrespectful expecting learners to memorise and accept what instructors say without questioning what is being said. Thus, in educational settings, students should be explicitly given the distinction between explanations and argumentation (Osborne & Patterson, 2011).

ARGUMENTATION

Fundamentally, arguments represent the outward reasons to support questionable claims to obliterate or emphasise the doubts emerged from such a group of claims (Morrow & Weston, 2011; van Eemeren et al., 2013). In this sense, arguments would aim at supporting claims to reinforce the essence of the information in it or, contrarily, they would represent the mean to clarify and remove the doubts implicit to the claim (Walton, 2006a, Walton, 2006b). From this perspective, in the education field, arguments should be used with two primary purposes: the reinforcement of the content being taught; the stimulation of critical thinking skills (Newell et al., 2015). To lecturers, the timely need of creating pedagogical situations leading to apprentices' meaningful learning should involve conditions to promote in students critical and analytical skills far to be perceived as directionless arguments and claims –because students' competence on the construction of explanations and argumentation increases when they are engaged in the inquiry praxis or process (McNeill & Krajcik, 2009). To Walton (1999a), arguments represent a concatenation of propositional reasoning where formerly inferred propositions serve as premises. The same author does also state that arguments differ from explanations because the former are *unsettled* issues or statements opened to opposite perspectives or points of view; while explanations are *settled* statements or propositions prone to be lengthened. In a classroom environment, an explanation could be the instructional content given in a lecture; and the argument could be the debate emerged from the curricular content. Since the misinterpretations of explanations as arguments can lead to the erroneous analysis of the last one, the distinction between both of them is crucial (Walton, 2015b). Having said so, a way of transposing subject-matter explanations into arguments might be transferring a set of settled statements to real-life situations, as well as the presentation of new ideas by the students. To Passmore and Svoboda (2012, p. 1536), more research in support of 'both content learning and authentic experiences' is needed in classroom environments. In the classroom environment, a way of questioning students' arguments can be asking them the appropriate critical questions to raise doubts on the acceptability of the argumentations provided by them (Walton, 2009a).

Since everyday arguments belong to informal logic, numerous experts believe that formal logic has been emphasised to a large extent and that 'all serious [pejoratively] reasoning is deductive in nature' (Walton, 1999b, p. 219). Though it can be applied to informal logic, to Walton (2013a, p. 3), the theory underlying logical argumentation is widener than the one from informal logic 'because of its integration with artificial intelligence and because of its aim of providing assistance with the task of argument invention, as well as the tasks of argument identification, analysis and evaluation.' Even though informal logic seems to be the antagonist to formal logic, there is a need for establishing formal structures assisting in the assessment of applied arguments, though the issue to argument evaluation relies on that 'classical deductive logic is not of practical use in modelling the concept of relevance that is so central to informal logic' (Walton, 1999b, p. 219). Since informal logic arguments need to be evaluated considering its relevance or irrelevance –and formal deductive logic might not do it– the use of formal logic for the evaluation of arguments in practical reasoning or natural situations should not be promoted (Walton, 1999b). Yet arguments can be assessed through a more realistic or applied logic, instead of the more formal methods like deductive logic, where the organised formative assessment 'have the goal of making sense of and acting on the world' (Smith et al., 2006, p. 8). Rather than considering arguments as the set of statements forwarded by the support of previous statements, Walton (1992a) proposes a model that considers the pros and cons of each specific argument taking place in every particular context. Apropos of the evaluation of everyday arguments, both dialogue type and relevance influence on

argumentations' acceptability, as well as on the specific importance of a move in widened contexts of dialogism (Walton, 1992b).

Despite the increasing relation between the argumentation theory and the artificial intelligence field (Walton, 2013a), arguments remain as the primary substance in quotidian manifestations as debates, presentations, negotiations, demonstrations, et cetera. Indeed, such teaching-learning tools for the development of argumentation should be accompanied by a curricular content that gradually increases its complexity 'as students develop a deeper understanding' of it (Berland & McNeill, 2010, p. 788). Though arguments take place in different occurring natural contexts, to Woods et al. (2004) arguments are distinctive in both narrowing and broadening logical senses. For these authors, arguments in the broad sense involve *social* factors in that two or more arguers participate in the claim(s). Also, from this broad perspective, arguments (1) happen in a real-time span, (2) involve implicit or explicit rules regulating them –as well as the evidence or premises for its support–, (3) entail the acceptance or refusal of a claim's conclusion. In conversational argumentation, monopolising the conversation is against the standard normative that considers turn-taking as preventing the other party from making his or her move (Walton, 2014a). Complementarily, in the narrow sense, arguments involve *technical* factors leading to an end via the multiple sequences of propositions and the relation between them. From the set of propositions, one of the numerous sequences represents the argument's conclusion; while the rest represents the argument's premisses. Within the argumentation settings and boundaries, broad and narrow senses are interdependent because 'If the narrow (or core) argument is defective, so too is the more broad (or social) argument' (Woods et al., 2004, p. 2). An example of broad, or social, sense argumentation occurring at life in academia would be the scientific presentations –where the narrow sense would be the techniques used along with the carried debate, presentation, negotiation, or demonstration as premises in the core argument leading to a conclusion. Yet 'Logic in both the broad and the narrow sense is an element of *critical thinking*' (Woods et al., 2004, p. 3).

Argumentation Schemes

Argumentation schemes are the structures of arguments managed in day-to-day discourse. They constitute the diversified forms of arguments that provide shape to the stereotypical patterns of reasoning and inferencing (Walton & Reed, 2003). 'Argumentation schemes are forms of argument (structures of inference) that represent [chained] structures of common types of arguments used in everyday discourse, as well as in special contexts like those of legal argumentation and scientific argumentation' (Walton et al., 2008, p. 1). Such schemes are patterns of reasoning leading to the identification and evaluation of conventional and stereotyped argumentation in daily discourse acts from where emerges the set of critical enquiries matching the appropriate scheme. In discussions by students about, for example, conceptual matters emerged from a science subject, schemes represent the analytical and illustrative moves in the given discourse (Alexopoulou & Driver, 1997). Notwithstanding argumentation schemes are structures of inference, they also constitute both inductive and deductive forms of arguing and reasoning (Walton et al., 2008). Because they both do not deal with all valid argument patterns, deductive and inductive logic must be complemented by applied logic based on argumentation schemes (Walton, 2002). Additionally, for the understanding of erroneous arguments or fallacies, knowledge on argumentation schemes is necessary, so the type of argument being misused can be ascertained (Walton, 2013b). An example of the schemes' function would be the analysis of natural arguments to observe reasonability, correctness, or standards in them. Through a coded scheme focused on difficulties exhibited by students with data

manipulation and analysis, Hug and McNeill (2008) point out towards the necessity of engaging students in the collection of data from primary sources or first-hand data experiences. Considering argumentation schemes from the context and dialogue viewpoints, it seems 'that argumentation schemes have more of a rhetorical or persuasive function than a logical function. They represent ways of communicating an argument in a dialogue, regarding the conventions of what kinds of moves or speech acts are conventionally accepted in that type of dialogue' (Walton, 2013b loc. 506). In the classroom context, argumentation schemes can be used to analyse the different types of arguments throughout the elaboration of critical questions fitting them (Newell, 2011).

Concerning the study of fallacies, argumentation schemes are relevant in the way that they represent an initial step on their research (Walton, 2013b). As innovative, Walton (1995) provides argumentation schemes from a more pragmatic and descriptive approach that understands and analyses argument schemes in connection with fallacies. At times, arguments can also be questioned by revealing dubiousness both on the source of information honesty or on the premises trustworthiness (Walton, 2013a). The premises –taken as valid because the source is assumed to be an expert– sometimes reveal themselves as fallacies because of its intentional or unintentional provided accuracy on the information: 'Source *a* is in position to know about things in a certain subject domain *S* containing proposition $A \rightarrow a$ asserts that *A* is true (false) $\rightarrow$ *A* is true (false)' (Walton, 2013a, p. 97). If such principles were applied to a specific university environment it could be said that, in a discussion between students, some might consciously aim at committing fallacies. The reasons for such a commission could rely on that they might 'want to show that they are better than the other students by using strong but fallacious arguments to try to refute the arguments of their opponents. [or, they] want to *impress* [emphasis added] their professor [to] get a better grade in the course' (Walton, 2013a, p. 219). Be that as it may, concerning mind aspects, there is also revealing information to be ascertained from those biased (van Benthem, 2009). To Walton (2013a), the properties of informal fallacies are studied through tools like argumentation schemes and formal dialogue models. Thus, many forms of argument linked to fallacies are analysed through argumentation schemes (Walton et al., 2008a). In the education field, the argumentative skills are perceived as meta-strategic; and the conceptual profundity assigned to the ideas manifested by argumentators constitutes an indicator of argumentative quality (Rapanta et al., 2013). Apropos of English language learners (ELLs) and the teaching of an argumentation-focused curriculum, there is 'a need to identify and develop supports for the dialogic aspects of argumentation' and a 'need for language supports that make the rationale for argumentation explicit since such transparency could further increase access [conceptual profundity] for all students' (González-Howard et al., 2017, p. 15).

Displaying meta-strategic competence and giving conceptual profundity to arguments imply the discernible identification of the adequate group of critical questions engaging the distinct argumentation schemes. In this sense, complementing the schemes that connect arguments sequentially, there is always a sequence of critical questions and answers for the evaluation of arguments (Walton, 2013a; Walton, 2005a). That is to say, 'Corresponding to each argumentation scheme [there] is a set of appropriate critical questions' (Walton, 1998, p. 211). Though –in a dialogue– identifying critical questions to engage the argumentation scheme *might* not be a simple task, argument and debate are two elements 'virtually absent from science education' (Osborne, 2010, p. 463). In a persuasion dialogue, the role of the opponent is to dismantle the argumentation schemes of the proponent through fitting critical questions impeding him or her to prove the argument's thesis (Walton, 1999a). To detect the critical questions best fitting the argumentation schemes, enquirers might have to consider both the other party expertise and the enquired critical questions allowing them to 'gain a sufficiently clear grasp [. . .] to pursue an

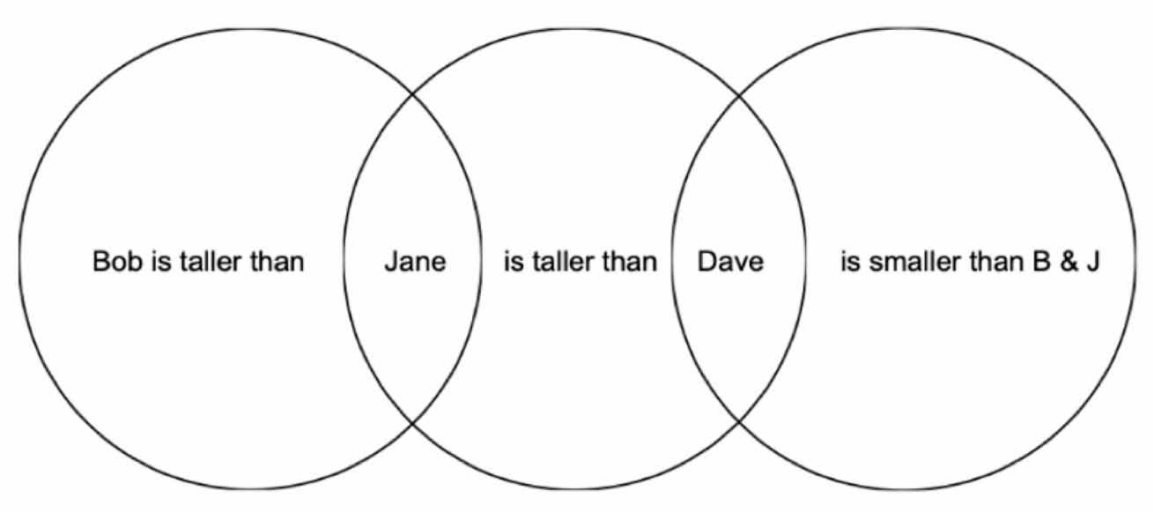
intelligent course of action' (Walton, 1999a, p. 45). Since the fitting of all of the argumentation schemes and critical questions into a formal structure does not constitute a simple task to deal with, to Walton and Reed (2003a), sometimes the connection between argumentation schemes and critical questions vanishes because of the lack of precise matching between them and the acceptability or redundancy of the critical questions on the premises (for more about critical thinking and enquiring, see 5). To these authors, new software systems might be helpful to state technical questions to formalise argumentation schemes. Other research also confirm the use of computerised graphic organisers or mind maps –for argument diagramming– to visually organise and scaffold arguments (Erduran, 2007; Stegmann et al. 2007). Hence, the proposed theory for the arrangement of computerised critical questions as virtual aid in classrooms remains as follows (Walton & Reed, 2003a, p. 195):

- **Rich** and sufficiently exhaustive to cover a large proportion of naturally occurring argument;
- **Simple**, so that it can be taught in the classroom, and applied by students;
- **Fine-Grained**, so that it can be useful employed both as a normative and evaluative system;
- **Rigorous**, and fully specified, so that it might be represented in a computational language such as XML,
- **Clear**, so that it can be integrated into traditional diagramming technique.

Argument Diagramming

In arguments, a way of portraying the reasoning structure from a given text, or a given discourse, is through *argument chaining* and *argument diagraming* (Reed et al., 2007; Walton, 2004a; Walton, 2004b). Such a primary method of informal logic encompasses two main referents: *nodes* containing the premises and conclusions producing propositions; *arrows* that represent the inferences and link the nodes (Freeman, 1991, in Walton, 2005a). The connection between the nodes and the arrows symbolise the chain of argumentation culminating in a *probandum*, or final conclusion, of the claim to be proved or put into doubt –e.g., in a trial, the ultimate proposition proving a suspect as guilty (or innocent) of having committed (or not) a crime (Walton, 2005a). To Reed et al. (2007, p. 87), though 'argument diagramming is [a] widely used [technique] in informal logic' its more recent application exhibits itself in artificial intelligence and computer science –where the argument diagram tooling is also recognised by the name of argument map (Walton, 2016). Apart from making the argumentation diagramming more precise and sophisticated, the advances in computer software engineering allow researchers to type discourses or texts for the late diagram visualisation and analysis (Reed et al., 2004a; Rowe et al., 2006; Walton, 2019; Walton, 2016; Walton, 2005b). Notwithstanding there is not abundant bibliography about argument diagramming in education, amongst other resources and criteria, Rapanta et al. (2013) make use of argument diagrams for the assessment of argumentation skills and the epistemic quality of arguments by the targeted participants. From both practical and pedagogical perspectives, the diagramming of natural arguments is likewise ascertained as a relevant topic (Reed & Walton, 2005). Apart from serving for the representation and the assessment of knowledge, diagrams also serve to represent the inclusive and exclusive relation of logical propositions: 'All *A* is all *B;* All *A* is some *B;* Some *A* is all *B;* Some *A* is some *B;* No *A* is any *B*' (Venn, 1881, p. 8). From a collaborative perspective, online graphic organisers can help students organise and represent their arguments (Dowell, 2009). Concerning propositional relatedness, reflexiveness, and overlapping, *T* represents the set of identifiable topics where the propositions *A* and *B* have subject-matter areas in common (Walton, 2004). To Walton (2004), subject-matter overlap

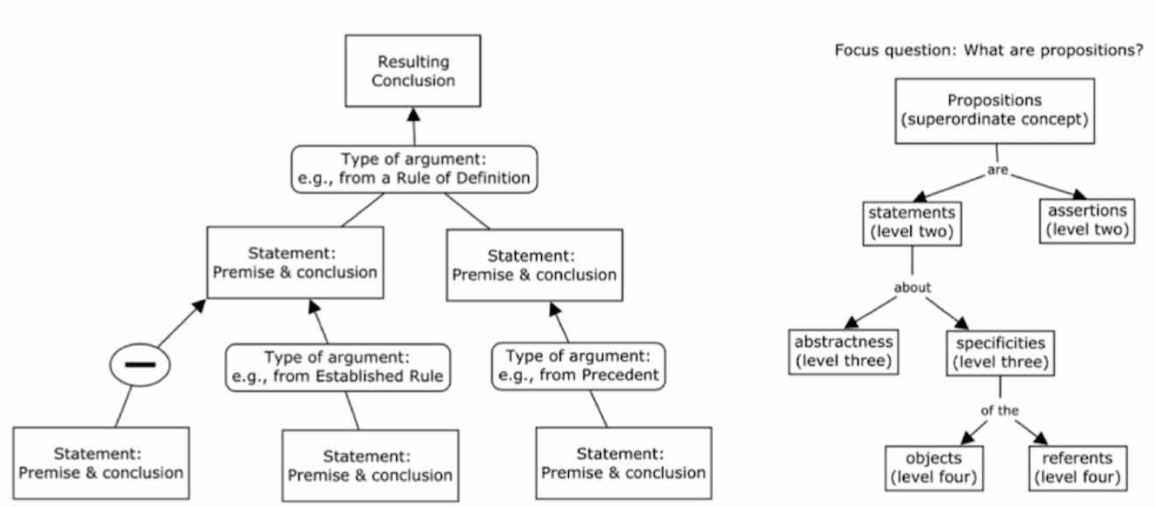
Figure 1. Subject-matter overlapping and transitivity
Note. Self elaboration by means of Diagrammix –text adapted from Walton (2004).



is symmetrical –'if *A* is related to *B*, then *B* is also related to *A*' (p. 96). In education, Venn diagrams can be used to represent the relation and the (non-)transition of propositions (*Figure 1*). An example of the failure of transitivity in overlapping relations would be as follows (adapted from Walton, 2004, p. 97): (*A*) Grapes are nutritious. (*B*) Bob used scissors to cut grapes. (*C*) My scissors are yellow.

To Rapanta and Walton (2016), in the software market there are numerous tools for argument mapping to support, visualise, and assess students' argumentation. In education, Rapanta and Walton (2016) state that current research studies on argument mapping furnish a wide range of positive and negative results and uses of it: content and reasoning visualisation; scaffolding of critical thinking and writing; finding of consistencies, conflicts, or relations between arguments. Though some of the principles underlying argument mapping might differ from those of concept mapping, both instruments display similarities –e.g., concept maps entail both *nodes* and *arrows* and, in the education field, they are helpful instruments for content creation, visualisation, organisation, and assessment (Novak, 1998/2010). Apropos of assessment and the utilisation of argument mapping tools in education, there is seldom 'explicit connection to the assessment of the arguments produced from an informal logic perspective' (Rapanta & Walton, 2016, p. 212). The classroom use of argument diagramming could be to prompt in students reasoning skills. That is to say, through a series of hierarchically ordered propositional inferences, the reasoning is prompted logically (Walton, 1990). In *Figure 2*, a comparison between an argument diagram and a concept map is represented. In the argument diagram, the reasoning structure is displayed in a tree format, where the resulting conclusion is at the top of the hierarchical frame. In the structure, the squared (text) boxes are the statements –premises and conclusions of the arguments–; the rounded nodes are the type of arguments; and the arrows linking the nodes to the squared (text) boxes are the inferences from the premises to the conclusions (Macagno & Walton, 2017; Walton, 2018). Though argument graphs are not necessarily restricted to trees (Gordon & Walton, 2006), 'In many instances, the conclusion of one argument becomes a premise in the next one, producing a chain of argumentation terminating in the root of the tree at the top' (Walton, 2018, p. 57). Hence, in a tree graph, the *path* is a linear sequence of points comprising no *cycles* (Walton, 2020; Walton, 1979). Similarly, concept maps are hierarchical networks

Figure 2. Argument diagram (left) and concept map (right) representations
Note. Self elaboration via CmapTools –argument diagram adapted from Walton (2018). Concept maps can also be read as Level 0 (superordinate concept), Level 1 (referenced here as Level 2), Level 2 (referenced as Level 3), and so forth.



consisting of nodes and directional arrows linking such nodes. However, in the case of concept maps, the linking arrows encompass the explanations –linking words– on the relation between the group of nodes paired, generating propositions (Novak, 1998/2010). Since trees are connected graphs representing no cycles (Benjamin et al., 2015; Gross et al. 2019; Meng et al., 2007), not all the concept maps are trees.

FALLACIES

Far from being something new, the concept of fallacy yet appears on Aristotle's argumentation manual *On Sophistical Refutations* (Walton, 1995). Despite revealing a psychological dimension, in informal logic and argumentation, fallacies constitute the principles violating the standards linked to rational thinking and arguing (van Eemeren & Grootendorst, 1987; Walton, 2010a). According to van Eemeren and Grootendorst (1987, in Walton, 1995), fallacies are incorrect moves in arguments hindering the examination of the truth in a critical discussion throughout defective argumentation. However, to Walton (1987a), in not all the situations fallacies are meant to be fallacious. In education, a problem emerged from teaching students arguments linked to fallacies is that, as soon as they identify the characteristics of an argument, they fast assume it as a fallacy without scrutinising and analysing it critically and sharply (Walton, 2000a). Thus, if teachers aim at having students reaching successfully competing claims resolutions, they must consider making students aware of fallacies and the issues emerged throughout the discourse process (Zohar, 2007). Concerning the theories of fallacies, the pragmatic and the pragma-dialectical perspectives are the most commonly developed (Walton, 2013a). From the pragmatic theory, there are six fundamental characteristics of fallacies stating the conditions to be considered about them (Walton, 2013a, pp. 213–214):

1. A fallacy is a failure, lapse or error, subject to criticism, correction or rebuttal.

2. A fallacy is a failure that occurs in what is supposed to be an argument.
3. A fallacy is associated with a deception or illusion.
4. A fallacy is a violation of one or more of the maxims of reasonable dialogue or a departure from acceptable procedures in that type of dialogue.
5. A fallacy is an instance of an underlying, systematic kind of wrongly applied technique of reasonable argumentation.
6. A fallacy is a serious violation, as opposed to an incidental blunder, error or weakness of execution.

As aforementioned, it can be observed that fallacies are linked to (defeasible) argumentation schemes, where arguments are –consciously or unconsciously– fallacious (Walton, 2013a). Apropos of the dichotomic association fallacy-argumentation, Walton et al. (2008) analysed its correlation through argumentation schemes –sorting a twelve-item list where, from the major ones, twelve informal fallacies are urged to be analysed through defeasible argumentation schemes. Thus, in the study of fallacies, it is necessary to discriminate the three tasks involved in the argument being managed: identification, analysis, and evaluation (Walton, 1998). In conditions of dubiousness, manipulation, uncertainty, or persuasion, a decision-maker can think (intentionally or unintentionally) of faulty quick rules to solve an emerged problem or difficult or uncomfortable situation. In education, this phenomenon could be originated by utterly misunderstood concepts; by the pressure exerted in students to manifest wrongly understood concepts; or by an onerous classroom atmosphere making students hide their lack of understanding on a topic (Ausubel et al., 1983/2010). Throughout the appropriate virtual aid, *misconceptions* can also serve for students to locate a conceptual change in argumentation (Clark et al., 2007). Other ways of criticising arguments as fallacious can be both 'implying that the argument has committed a serious logical error [or] implying that the argument is based on an underlying flaw or misconception of reasoning' (Walton, 2008b, p. 15).

Informal Fallacies

Informal fallacies are the defective premises for the evaluation of reasoning about the content of a given argument (Finocchiaro, 1981). That is, an informal fallacy is an argument that, despite seemingly manifesting convincing and persuasive inferences, reveals defective premises or conclusions (Walton, 2009b). A typical example of fallacious argumentation is when the argumentator hastens –hasty conclusion or hasty generalisation (Walton, 2009c)– when leading to a conclusion, or does not adequately justify the premises of such an argument (Walton & Gordon, 2009). Thus, informal fallacies are discerned through the scrutiny of the premises or the conclusion of a given argument. 'At any rate, it appears to be highly significant to the study of informal fallacies generally that there might be different kinds or contexts of a fallacy, depending on whether the context of [the] argument is that of demonstrative or dialectical reasoning' (Walton, 1990, p. 416). In this sense, informal fallacies might also emerge from erroneous inferences or principles taking as true and valid what everyone does or says, which is a form of bias in argumentation (Walton, 1999a). For informal fallacies to be exhorted, argument issues on what is to be disputed about must be given as well –'At least the informal fallacies strongly require this notion' (Walton, 1987a, p. 18). Substantially and briefly compared, it can be adduced that 'Formal fallacies are faults in *reasoning* [emphasis added]' and 'Informal fallacies are dialectical faults in *argumentation* [emphasis added]' (Walton, 2014b, p. 103).

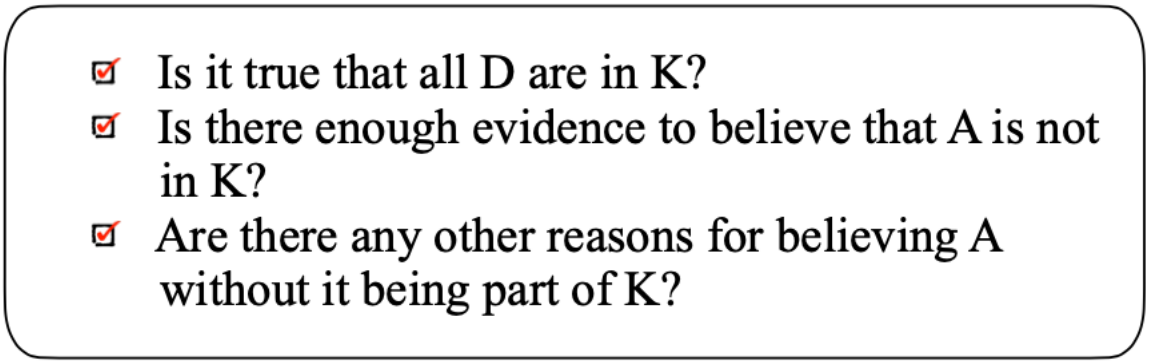
Notwithstanding contemporary logic textbooks are currently providing more information in the area, the subject of informal fallacies fails to care for it properly –probably because disciplines as psychology and formal logic tend to neglect them (Woods & Walton, 1975). Consequently, informal fallacies remain prone to be developed. Also, in the past, 'the promise of formal symbolic logic to provide a dialectical method for the evaluation of philosophical or practical argumentation was never fulfilled' (Walton, 2007a, p. 17). Albeit they are natural in language argumentation, Rapanta and Walton (2015) state that there is not much educational research focusing on fallacies identification for the assessment. For educators, prompting students' awareness of the most common informal fallacies likely to happen in classroom settings *might* lead the latest to understand better and classify fallacious arguments and the elaboration of critical queries best fitting them. A type of dialogue inquiry-based requires an opening situation encompassing the necessity to have any proofs or evidence. From that point on, the goal of the participants is to locate and confirm such evidence to reach the aim of the dialogue –proving or disproving the established hypothesis (Walton, 2010b). Other fallacies subjected to critical questioning are those eliciting emotional meanings where, despite being persuasive, the unnoticeable arguments are –to a large extent– based on presuppositions (Macagno & Walton, 2010). As can be witnessed, the consequence of teaching students to recognise how informal fallacies relate to critical questions will determine the latter design and elaboration of the queries by them –inquiry skills in the form of 'finely calibrated assessment instruments' (Kuhn, 2008, p. 40) permitting teachers getting an appropriate feedback on the students' inquiring and reasoning skills. Therefore, a brief description of the fallacies most likely to occur in educational contexts is displayed, as well as the questions that teachers can ask to guide the assessment process. For a more precise understanding of the upcoming sub-sections (as the types of arguments commonly given in classroom environments), a brief example of their structure is presented below:

a. Explanation of the fallacy or type of argument –e.g., Quite frequently, oral (or written) texts in conversation are semantically or syntactically so complex that even professionals find them ambiguous and of difficult interpretation (Walton, 2020). Hence, an argument is said to be amphibological when it takes two or more directions at once. In the case of amphibologies, instead of word meaning, the ambiguities correlate with grammatical issues at the sentence or phrase level –construction of not one (equivocation) but more than one (amphibology) term providing distinct interpretations to the sentence (Walton, 1987a).
b. Critical questions fitting the (in this case amphibological) fallacy or argument. Is *a* a liar? Has *a* poor judgment? Does *a* ignore facts? Is *a* illogical? Does *a* lack on moral virtue?

Ad Ignorantiam

The *argumentum ad ignorantiam* –also argument from ignorance, negative evidence, lack-of-evidence argument, and *ex silentio* argument– is a type of argumentation where part of the dialectical sequence has to be inferred or implied from what is omitted (Walton, 1999d). In this type of arguments, the 'lack of knowledge is [also] used as a premiss to argue to the conclusion that some proposition is true or false' (Walton, 1987a, p. 9). For example, an arguer can elaborate an *ad ignorantiam* fallacy aiming at proving a proposition whose premise has not been proved already ('extra-sensory perception must exist because nobody has ever been able to prove that it doesn't exist' [Walton, 1987a, p. 105]). Such a type of argument is based on hypothetical reasoning that is normally inconclusive (proposition *A* has not been

Figure 3. Suggested critical questions
Note. Adapted from Rapanta and Walton (2016, p. 215).

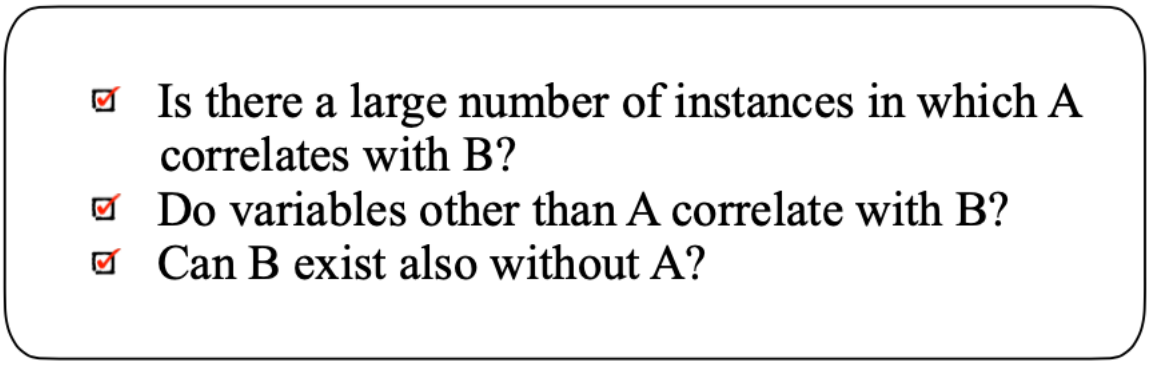


proved, or is not known, as true [false]; therefore it is false ([true]). In consequence, especially concerning science[1], it is fundamental to be cautious on the devising of either positive or negative inferences in this type of arguments (Walton, 2007b). In classroom settings, such a situation might appear when arguer *a* presumes on something as true without having to prove it. However, had the other party in the argumentation (arguer *b*) proved differently, arguer *a* would have to retract of some (or all) of the things previously said if the information is demonstrated to be false (Walton, 2007c). In this particular case, *A* would be false because it is not in *K* –and all of 'the true propositions of domain D in knowledge are contained in K' (Rapanta & Walton, 2016, p. 215). Because such arguments rely on unknown or not been proved information (real evidence), sometimes the argument is strengthened with a thoroughness search on the general information proving that there is nothing in the files that could disprove them –i.e., '**Inquirer:** Is Mr. *X* a foreign spy? **Security Service:** A thorough and complete security search yielded no evidence that Mr. *X* is a foreign spy. **Inquirer:** By inference I draw the conclusion that Mr. *X* is not a foreign spy' (Walton, 2014a; Walton, 1999d, p. 68). To Gaskins (in Walton & Macagno, 2010), arguments from ignorance mould the implicit structures on growingly usual styles concerning general public argumentation –e.g. 'Since you cannot prove me wrong, I am right.' Such aspect might also boost in the general public an increasing tendency towards the acceptance of pseudoscience.

Post Hoc

The argument *post hoc*, *ergo propter hoc* –also known as the argument from correlation to cause– pertains to the type of fallacies linked to statistical reasoning and induction, where the conclusions rely on casual and statistical correlations between the pair of events (Walton, 2008b). That is to say, in the *post hoc* fallacy, a second event is caused by a first event because there exists a positive correlation between the two of them (Walton, 2008b; Walton, 2002; Walton, 1987a). To Walton (2008b), this argument is regularly said to be a fallacy because the correlation between the dyad of events can, sometimes, be a mere coincidence turning out to a fast and unfounded conclusion omitting different points of view or perspectives. Because of its structure, *post hoc* argumentation belongs to the group of inductive fallacies ('two events A and B are approximately spatiotemporally coincident, [where] we may say that A and B are related in the sense that A could possibly be a cause of B' [Walton, 1987a, p. 2017]). In

Figure 4. Suggested critical questions
Note. Adapted from Rapanta and Walton (2015, p. 125).

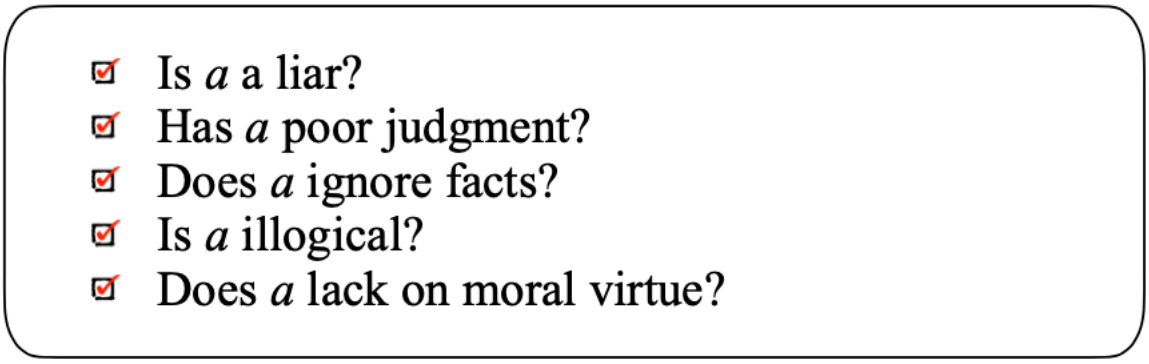


the education field, magical thinking (or some other superstitious and false beliefs) can originate that, despite the non-existence of any reasonable causal connection between them, students think of unlinked events in causal connection. To Shweder et al. (1977, p. 637), 'magical thinking is an expression of a universal disinclination of normal adults to draw correlational lessons from their experience, coupled with a universal inclination to seek symbolic and meaningful connections [. . .] among objects and events.' In the argument *post hoc*, it is necessary to distinguish a *function* –the shred of evidence for causal attribution– from the *causation* –the productive or preventive cause of an effect (Woods & Walton, 1977). Thus, instructors from any level, especially those who teach science contents, should make students aware of the interpretation of well-established statements contributing to the obliteration of deep-rooted, presupposed, and foundationless backgrounds. The goal of such awareness is to boost in students a subtle cognitive reorganisation of causation from the magical to the scientific thought. On occasions, causality relies on the selective interpretation of the external events by individuals (logical reasoning filtering the signals received). In this sense, the causal expectations are imposed by a logical completion of sequentially perceived events whose foundations rely on patterns or routines well known by the person (Walton, 2008b). For the establishment of a well-founded causal correlation, it is necessary a conclusive link between A and B prone to be proved through 'a clear theoretical understanding of the mechanism whereby *A* is causally related to *B*' (Walton, 2013a, p. 190). That is to say: *x* caused *y* if, and only if; N(1) *y* did not precede *x*; N(2) *x* is a complex of events each component $x_1 \cup x_2 \cup \ldots x_n = x$ is logically sufficient for *y* (Woods & Walton, 1977, p. 574).

Ad Hominem

To Krabbe and Walton (1993), the *argumentum ad hominem* is the argument where one of the participants in a dialogue discredit the opponent believes. To Walton (1998a), in the scholarly narrative, there are two main commonly *ad hominem* subtypes used for discrediting arguments: abusive and circumstantial. The abusive *ad hominem* subtype is used to attack speakers directly –making them aware that they are not reliable, sincere, or trustworthy participants. The circumstantial *ad hominem* subtype is used for claiming the inconsistency of the argument conditioned by the orator circumstances. One example of circumstantial *ad hominem* (fallacious) argument could be the case of a politician advocating 'keeping government expenses down by not giving out inflationary salary raises to government officials, but it

Figure 5. Suggested critical questions
Note. Adapted from Walton (1998a, p. 191).



is later revealed that, once elected, he has given himself a large increase to his already sizable salary. A critic [to the politician] may then say "You do not practise what you preach!"' (Krabbe & Walton, 1993, p. 87). In this case, not only allegation's inconsistency is questionable but also the sincerity and the ethics of the arguer –attack against the argumentative position and the circumstances, not against the speaker's character. Concerning children, being involved in situations where adults –like, for example, teachers, legal tutors or parents– say one thing but act differently might originate in them cognitive conflict and frustration (Walton, 1998a). Apropos of the abusive *ad hominem* subtype, it is necessary to understand the connection between the character and practical reasoning. For example, for characters not having to deal with a direct attack for being dishonest, irrational, or unmoral 'prudence in making choices for solving practical problems is a key skill' (Walton, 1998a, p. 189). Hence, both character's reputation and background are influenced by the previous patterns of action and commitments of the person herself (Walton, 1998a). In the classroom environment, *ad hominem* fallacies might emerge from impulsive students providing information without thinking about what is being said. *Ad hominem* attacks might also be used to target persons (or pupils) whose points of view or behaviours are divergent from the ideology of the group (Krabbe & Walton, 1993, CASE 7a). In (group or pair classroom) debates or critical discussions, *ad hominem* arguments are not considered appropriate (Walton, 2000b).

PREMISES AND PROPOSITIONS

Propositions are the written or spoken statements revealing either true or not true (yet not both) judgements or opinions (Walton, 2018). From the most austere perspective, the arranged sets of propositions outline the varied arguments (Walton, 1982). Furthermore, in an argument, the propositions are divided into two subcategories: the *premises** of the argument and the *conclusion*** of it (Walton, 1987a). However, not only an argument must be interpreted as the group of isolated propositions, 'but also as an extended chain of arguments in the context of a continuous discourse, issue, or discussion' (Walton, 1987a, p. 2). That being so, arguments are 'defined as a set of statements [. . .] called the premises of the argument that lead by an inference to [. . .] the conclusion' (Macagno & Walton, 2017, p. 162). Apart from acting as goal-directed units of the move, when arranged logically, propositions provide to arguments the necessary correctness, flow, and adequacy (Walton, 1998a; Walton, 1982). Propositions

Table 1. Aristotle's categorical propositions

Universal Affirmative:	All *S* are *P*	All politicians are liars
Universal Negative:	No *S* are *P*	No politicians are liars
Particular Affirmative:	Some *S* are *P*	Some politicians are liars
Particular Negative:	Some *S* are not *P*	Some politicians are not liars

Note. Adapted from Woods et al. (2004, p. 176).

do also play an essential role in the reaching of a conclusion. That is to say, on the support or other propositions accepted as true, the propositional conclusion can or cannot be accepted as true –e.g., In a trial, the credibility of a witness diminishes when –from the group of propositions that he or she gives are assumpted by the jury as being true and plausible– there is evidence that one of the propositions provided by the witness is false (Walton, 2002). As referenced, formal logic methods can be helpful to the study of both inferences and fallacies. For example, throughout formal methods, propositions can be analysed categorically and relationally. Thus, propositional logic encompasses the *relation* between propositions; while categorical propositions (*Table 1*) encompass the internal logical *structure* of them –such as its validity (Woods et al., 2004). The basic formal system of propositional logic –*system P*– 'provides a systematic way of studying the consequence relation and all the logical properties and relations' (Woods et al., 2004, p. 123). Elementary systems involve truth-functional, or propositional, connectives leading to the identification of valid arguments: ~ (negation); ∨ (disjunction); ∧ (conjunction); ⊃ (implication); ≡ (equivalence). With regard to the internal structure of atomic and categorical propositions, syllogisms are relevant for a deductive inference or reasoning of an argument: *All men are mortal. *Socrates is a man. **Therefore, Socrates is mortal (Woods et al., 2004).

CRITICAL THINKING AND ENQUIRING

Logic constitutes an element of critical thinking, where critical thinking not only includes the critical assessment of arguments but also the critical assessment of non-argumentative discourse (Woods et al., 2004). Hence, the goal of critical thinking consists in the evaluation of divergent arguments and the subsequent provision of convincing reasons to reach a conclusion being accepted by the other party in the dialogue (Walton, 2006a). To reach its end and the directed goals, the act of critical thinking co-occurs with other verbal actions like enquiring, knowing, organising, analysing, argumenting, et cetera. That is to say, the *critical* assortment of cognitive skills permit humans extracting, constructing, elaborating, revising, and updating information from the real world (Kuhn, 2008). From this perspective, critical thinking encompasses attitudes, knowledge, and competencies involving the scrutiny, analysis, and rebuttal of arguments. Also, 'To the extent [that] people intentionally engage and control their knowledge acquisition skills [. . .], their knowledge acquisition capabilities are significantly enhanced [. . .] when we seek to develop students' inquiry learning skills' (Kuhn, 2008, p. 61). Another essential competence in critical argumentation is the identification and correct answer of complex questions, so the nature of the loaded question itself does not turn detrimental to the speaker (Walton, 2006a). Through reasoned judgments and logical thinking, critical thinking is a relevant aspect in democratic systems. However, there exists the dilemma if the judgements –especially those legal or political– should be either con-

ditional or unconditional (Walton, 2006a). For Osborne (2010, in Macagno & Rapanta, 2019, p. 23), 'because argumentation is thought to enhance critical thinking skills', both argumentation and critical thinking tend to co-occur in educational research. Though there is no explicit reference on how the process happens, argument mapping is said to enhance critical thinking skills. Also, argument maps are considered useful for the scaffolding of both writing and critical thinking skills in scholars (Rapanta & Walton, 2016). Concerning business educators, instead of *heuristic*, there is a need for teaching learners *critical* thinking skills (Smith, 2003, in Rapanta & Walton, 2015). The reason is that –as it happens in bilingual education– 'business undergraduate education does not focus as much [as it should be] on argumentation' (p. 130).

As a formative assessment tool, another relevant aspect that should be seriously considered to be taught in education is enquiring (Cam, 1995; Fisher, 1996; Lipman, 1993; Lipman, 1991). Enquiring also represents a valuable resource for argument evaluation on certainty, uncertainty, or justification (Beardsley, 1950; Black, 1946, in Walton, 1998). Since fallacies relate with the asking and answering of questions, the managemental process of enquiring is fundamental to prove grounds in a dialogue (Walton, 1987a). In the Argumentation Schemes epigraph, it was briefly explained the connection between schemes and critical questions –where critical questions were revealed as instruments to evaluate and prove the strengths and weaknesses of questionable or dubious claims in arguments (Walton, 2006a; Walton & Reed, 2002). It is to be realised, however, the difference between critical questioning *vs* asking for an explanation. If a person asks *how* does something work, the expected answer will encompass an explanation on how such thing works; not an argument proving that it works (Walton, 2006a). Though they are quite similar and encompass statements acting as starting points leading to endpoints, to Walton (2006a), the difference between explanations and arguments relies on that in the former "the terms 'premises' and 'conclusions' are not used. Instead, there is a proposition that is queried or that is supposed to be explained" (p. 76). From a more pragmatic perspective, however, the idea is to ask (pragmatic) questions to see 'how the argument is being used to fulfil a goal of *argumentative* [emphasis added] dialogue' (Walton, 1998b, p. 10). Yet critical questions could be used in education as replies of schemes or to fulfil the argumentative goal of proving –optimistic or sceptical– positions on a given issue (environment, budget cuts, education policies, et cetera). Through critical questions matching the confronted argument, arguers elaborate succession of argumentation clues and evidence to refute or attack the opposing arguments (Macagno et al., 2017).

As it happens with critical argumentation, which is a *practical* skill needed to be taught from the starting point (Walton, 2006), critical thinking and critical inquiry skills leading to success and fruitful learning also require awareness on some fundaments. For example, teaching students the necessary critical strategies and mechanisms to elaborate critical questions might lead them to adequate content understanding (Kane, 2013). Şeker and Kömür (2008) concur with the educational approach presented in the introductory part of this writing because they consider fundamental that pre-service teachers *must* get training on critical thinking skills, so when they are in-service teachers can appropriately meet the teaching profession's expectations. At least in the education field, 'Developing questioning and critical thinking skills of learners cannot be [either] considered separately' (Şeker & Kömür, 2008, p. 389). Instead of the conventional epistemological perspective of knowledge, the critical analysis of evidence throughout argumentation is also a form of scientific inquiry leading to satisfactory research results (Walton & Zhang, 2012). A scientific model based on the critical examination, discussion, and questioning of arguments might lead students to acquire further authentic, deciphered, and *meaningful* knowledge. In education, a model based on the encouragement of the manifestations of the learners'

natural curiosity would lead them to higher intellectual understanding than other models based on the memorisation of established theoretical contents.

CONCLUSION

Since there is a direct relationship between how students learn and how such learning is assessed (Panadero, 2018), in education, formative assessment is the informative feedback making teachers to get awareness on students' understanding and to develop and rearrange (if necessary) the provided instruction (Greenstein, 2010). Notwithstanding self-assessment provides support to students in their efficient regulation and learning (Paris & Paris, 2001), 'teachers [must also] create classroom environments in which students have opportunities to seek challenges, to reflect on their progress, and to take responsibility and pride in their accomplishments' (p. 99). In this sense, instead of assessing the specific curricular elements linked to –generally rote– learning, 'We need direct assessments of the kinds of complex reasoning and problem-solving skills that constitute higher order thinking' like, for example, 'The kinds of components [. . .] generating [in learners] multiple ideas and alternative viewpoints on a particular topic, generating summaries, skimming, figuring out word meanings from context, solving analogies and logical puzzles, and detecting logical reasoning fallacies' (Resnick, 1987, p. 46). During the instruction, we believe that argumentation and the elements involved in it (especially those concerning the critical inquiry as assessment *for* learning) should be considered in the classroom environments. There is also the need to point out toward future research lines to observe if students receiving training by teachers displaying awareness on informal logic and thinking, arguing, and critical questioning techniques are more prone to succeed academically. The reason is that, the fill-in-the-brain educational models via memorisation, misunderstandings, or lack of awareness on knowledge transfer should gradually be turned into more logically-based teaching and learning models. In this regard, '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 et al., 2000, in Rapanta & Christodoulou, 2019, p. 1), as well as on 'the assessment of students' argumentative competences' (Erduran et al., 2004; Felton & Kuhn, 2001; Rapanta et al., 2013, in Rapanta & Christodoulou, 2019, p. 1). Also, at times, the frustrating "parade of [didactic] educational 'innovations' [. . .] that seem to have accomplished so little" (Novak, 1998/2010, loc. 62), might constitute a barrier for the efficient improvement of education. Apropos of critical enquiring as assessment *for* learning, for a better understanding of evidence and specific terminology, inquiries constitute a reliable way to assess, interpret, compare, and link evidence (Rapanta, 2018). Making students aware of the learning process is also of help for them to master the organisation of their learning (Flavell et al., 1995). Thus, concerning didactics, we propose that both the inductively or deductively visual-representational instruments susceptible to be used in the classrooms for the ascertain and assessment of arguments, knowledge, and enquiring skills are those linked to knowledge mapping and organisation –e.g., argument maps, concept maps, or even mind maps.

In sum, the intention of the theoretical approach here presented has been to shortly issue the possible implications, relevance, and applications of informal logic mechanisms in educational settings. Actively listening and asking the right (formative) questions to each other help students expand and clarify given propositions and generate new knowledge based on peers' ideas (Michaels et al., 2007). However, providing adequate guidance to students through choir is not an easy task to instructors. To McNeill and Knight (2013), sometimes teachers display 'a limited understanding of how to apply argumentation to

make sense of students' classroom discussions' (p. 957) –an aspect that conditions teacher's instruction. For these authors, the perception of the content as separated from argumentation can also be a problem during the teaching and learning process. At this point, it is worth mentioning Montaigne's *Essays*, where a person with a well-shaped head is considered more virtuous than a person with a well-filled head. In Book I (Chapter 26), the author states that 'After the pupil has been told what serves to make him wiser and better, he must be taught the purpose of logic [. . .]: his judgement once formed, he will very soon master whichever branch he may choose.' Perhaps, –as long-ago stated by Montaigne– is yet philosophy 'a vain and chimerical name[?]' (in Cohen, 1958, p. 66). It is not the idea to draw into conclusions without the foundation of reliable quantitative and qualitative data upcoming from the intervention but, as it was disclosed in the introduction part, there is a need for reincorporating some philosophical principles in the curriculums of education (because the educational-curricular elements provide teachers with the necessary means to prompt *inquiry* skills in their students (Davis & Krajcik, 2005). Not necessarily have to be introduced all the elements of philosophy in such curriculums, but the ones that allow students to comprehend and master whichever branch they might be choosing in the future. As a cognitive constructivist principle, and at the beginner level, the aspects here presented on informal logic, and some other formal logic aspects might serve the roots to where, afterwards, students will subsume additional information. Also, methodological instruments like propositional formation, concept mapping, or argument mapping are considered of relevance for knowledge acquisition and assessment. Thus, the substrate of the theoretical framework here presented is not only critical thinking or argumentation but rather the critical formulation of queries. However, since they lack on fundaments, the skills on the practical uses of this theory by neophyte pre-service teachers indeed require training and time for such expertise to be acquired. In any case, the didactic training of bilingual primary school teachers will –more or less positively and productively– influence the way how primary students develop knowledge, habits, and learn about the different perceptions of the conceptual reality.

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ENDNOTE

[1] Referred to as the ‘systematized knowledge derived from observation, study and experimentation carried on in order to determine the nature or principles of what is being studied’; or as ‘the use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process’ (Webster’s New World Dictionary 1305 & NASIM 2007, in Walton and Zhang 2012, p. 176).