Douglas Walton's Contributions in Education: A Synthesis of Theoretical and Empirical Research

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Abstract: Douglas Walton, perhaps the most prolific author in Argumentation theory, has been of a great influence in the fields of Informal logic, Artificial intelligence, and Law. His contributions in the field of educational research, in particular in the field of argumentation and education, are less known. This review paper aims at shedding light on those aspects of Walton's theory that have received educational researchers' attention thus far, as well identifying existing lacks of consideration and open paths for future research.

Résumé: Douglas Walton, peut-être l'auteur le plus prolifique de la théorie de l'argumentation, a eu une grande influence dans les domaines de la logique non-formelle, de l'intelligence artificielle et du droit. Ses contributions dans le domaine de la recherche en éducation, en particulier dans le domaine de l'argumentation et de l'éducation, sont moins connues. Cet article de synthèse vise à faire la lumière sur les aspects de la théorie de Walton qui ont retenu l'attention des chercheurs en éducation jusqu'à présent, ainsi qu'à identifier les manques de considération existants et les voies ouvertes pour de futures recherches.

Keywords: argumentation schemes, critical questions, educational research, dialogue theory, Douglas Walton

1. Introduction

Educational researchers are more and more interested in argumentation theory tools and developments. A field of research called "Argumentation and education" was even born recently, joining researchers with a deep interest in applying argumentation as a pedagogical method and/or as a tool of analysis and evaluation for students' arguments. For some years now a special interest group in "Argumentation, Dialogue and Reasoning" has been part of the

European Association of Research for Learning and Instruction (EARLI – SIG26), holding its own biannual meeting. Overall, there is vast evidence that argumentation theory has become a tool and method for educational research and is there to stay.

In the field of education, argumentation is mostly treated as a pedagogical method for developing and practising students' argumentation skills, such as the construction of claims supported by some type of evidence, and the offering of a reasoning (explanation) of how the claims and evidence are connected (McNeill and Krajcik 2011). This skill, also known as theory-evidence coordination, is a requisite for meaningful learning, as it assumes gains in metacognitive control evident from middle childhood to adolescence (Kuhn, Katz and Dean 2004). Through placing oneself in the position to justify what (s)he thinks about why and how a particular phenomenon occurs, (s)he is naturally urged to compare and use available evidence supporting one theory over another. This is why, through arguing, children and adolescents become more conscious of what they know, how they know, and how they can strategically use what they know to persuade others (Kuhn et al. 2013). But also on issues that do not require any specific discipline-related knowledge, such as the so-called general or social issues, argumentation is proven to be a successful vehicle for students transforming available information into evidential support for a defended position, while at the same time taking into consideration the two-fold evidential function of some information, or the fact that some information can be more adequately used to support an opponent's position rather than one's own (Iordanou and Kuhn 2020). Understanding this duality of potential evidence is highly important from an epistemological development point of view, as it implies an evaluativist perspective on knowledge, as opposed to a multiplicist or absolutist one (Kuhn, Cheney and Weinstock 2000; Nussbaum, Sinatra and Poliquin 2008).

However, as in any emerging area of research, the exact theoretical insights and frameworks used from the theoretical field of argumentation to inform the empirical field of education largely vary according to researchers' interests and willingness to get deep into the very roots of what they intend to apply as an innovative method of teaching, learning, and assessment. The present qualitative

synthesis paper aims at offering a comprehensive overview of what, how, and why has thus far mostly interested educational researchers when it comes to Douglas Walton's extensive theoretical work in the field of reasoning, dialogue and argumentation. Doing this, still underexploited parts of his theory will also be revealed opening new paths for educational researchers to innovate in their corresponding fields.

The paper is divided into thematic areas summarizing Walton's major existing and potential contributions in educational research, such as argumentation schemes, critical questions, and argumentation dialogue types. Each area will be theoretically and empirically explained and showcased by educational research when this is available. When it is not, possible paths for future research will be identified. A conclusion will summarize the theoretical and empirical evidence previously explained, and the corresponding identified gaps.

2. Walton's theory of argumentation schemes and its influence on education

Walton's theory of argumentation schemes is primarily proposed in two books, namely: *Argumentation schemes for presumptive reasoning* (Walton 1996) and *Argumentation schemes* (Walton, Reed, and Macagno 2008). The first only focuses on presumption as a reasoning context for arguments to emerge, while the second opens up to different types of reasoning such as deductive, inductive, and analogy. The numbers of schemes included in each also differs, with the former listing only twenty-five of such schemes, and the latter listing sixty. Before exploring the existing and potential contribution of this theoretical advancement in educational research, let us first briefly review the major innovations this idea has brought to argumentation theory.

Introducing presumption as the primary context in which everyday argumentation can take place has been largely innovative. As Blair (2001) comments, presumptions are neither assertions (typical of deductive reasoning) or assumptions (typical of inductive reasoning); they "come into play in the absence of firm evidence or knowledge" (p. 366). Initially situating arguments as instances of presumption is explained by Walton's emphasis on the dialogue

context as a framing and a criterion for a scheme to be validated. For Walton (1996), an argumentation scheme is nothing more than a pattern of a unit of reasoning situated locally in an argumentative dialogue. This idea was extended by Walton et al. (2008), whose aim was to provide a classification, as exhaustive as possible, of stereotypical patterns of the most common arguments emerging in everyday discourse. Rather than using some schemes to exemplify presumption, as in Walton (1996), Walton et al. (2008) systematically describe the argumentation schemes that were developed in the dialectical tradition (under different labels and theories) and organize them in macro-categories (analogy, classification, knowledge-based, ethotic, practical, and causal), distinguishing the basic schemes from their specifications and combinations.

The use of argumentation schemes as assessment tools in education is well justified, given that (a) pedagogical dialogue is a type of everyday dialogue and (b) scientific dialogue, commonly used as the basis for pedagogical dialogue, is highly presumptive. In Rapanta, Garcia-Mila, and Gilabert's (2013) review paper on educational argumentation research, among ninety-seven empirical studies dating from 1985 to 2010, twelve applied argumentation schemes as their main assessment method of students' argument skills. All of them refer to Walton (1996), which is quite limited as compared to Walton et al. (2008). Below I describe three of these studies as most representative of Rapanta et al.'s (2013) sample, before I describe a new search among more recent studies.

Ferretti, Lewis, and Andrews-Weckerly (2009) used seven argumentation schemes from Walton (1996) as a method of identifying middle-grade students' persuasive strategies in written essays about a general interest issue (viz., whether students should be given more homework or not). They showed that despite their demographic variance, students overwhelmingly used the argument from consequences scheme/strategy, which was considered adequate by the authors for the policy making issue concerned. However, when it comes to the quality of this and other schemes used, students largely failed to address the critical questions corresponding to each. As a result, the overall persuasive quality of their essays remained low.

Abi-El-Mona and Abd-El-Khalick (2006) used a combination of Toulmin (1958) argument pattern (TAP) and Walton's (1996)

presumptive reasoning schemes to analyze high-school students' oral arguments (ordinary classes, laboratory sessions, and interviews) in chemistry. Overall, students' arguments were found to be limited both in quantity and quality (applying TAP-related structure criteria). When it comes to the types of schemes used, the authors found that these varied across the three contexts, with the most developed ones being used in the interview context. This was justified by the structure of the interviews including probing and epistemic prompts, which led students to the manifestation of explicit reasoning structures in their discourse, such as arguments from sign, from example, or from analogy. Abi-El-Mona and Abd-El-Khalick's (2006) study confirms a previous result by Duschl, Ellenbogen, and Erduran (1999) and Duschl (2007) that students have a greater potential in argumentation than the one identified by strict analytical logical tools like TAP. Walton's schemes of presumptive reasoning can be a useful diagnostic tool for identifying students' strategic potential.

Also using a combination of Toulmin (1958) and Walton (1996), Jiménez-Aleixandre and Pereiro-Muñoz (2002) studied the quality of high-school students' arguments around a socio-scientific issue (viz., construction of a local drainpipes' network) during classroom discourse. The authors place a particular emphasis on the use of argument from authority by the students, when it comes to deciding who has the status of expert, within that deliberation context, and whether there is consistency with other experts and with other available evidence. Through engaging in this kind of advanced reasoning, the authors showed how students can pass from being "knowledge consumers" to becoming "knowledge producers," therefore citizens able to think critically about a social issue of high relevance for their lives.

Being interested in how Walton's schemes were used both theoretically and empirically after 2010, a new search was conducted in the largest scientific meta-database (Scopus), with the following keywords: 'argument* schemes,' 'education,' and 'Walton,' appearing in the full text of the sources. 254 articles emerged from this search. Of these, twenty articles were selected as appropriate because they explicitly described a theoretical appropriation and/or empirical implementation of Walton's et al. (2008) or Walton's

(1996) argumentation schemes in educational contexts. Figure 1 presents an overview of these articles, corresponding to seventeen studies (three studies were presented in more than one article). Figure1presents the main emerged contributions along with the implementation of the schemes used by these studies.

STUDY	STUDENTS' GRADE	FIELD/ TOPIC	CONTEXT	TYPES OF SCHEMES	USE
Basel et al. (2013)	secondary	Science	research interviews	causal schemes, example, analogy	argument analysis, assessment
DeLaPaz et al. (2012)	middle	History	writing (essay)	verbal classification, example, conséquence, expert opinion, comiment, values	argument analysis/assessment
DeLaPaz & Wissinger (2017)	middle	History	writing (essay)	expert opinion, consequence	teaching/fostering tool (critical)
Jin et al. (2016)	university	SSI	research interviews	example, authority, popularity, consquences	argument analysis/ assessment
Kim et al. (2014)	university	Science	group discussion	position to know (research), sign	argument analysis/assessment
Lazarou et al. (2016)	primary	Science	teacher's diary reflections on students' arguments during classroom discourse	expert opinion, analogy, cause to effect	argument analysis/assessment
Macagno & Konstantinidou (2013), Konstantinidou & Macagno (2013)	university	Science	writing (assignment)	cause to effect, analogy	argument analysis/assessment
Macagno et al. (2015)	middle	Social issue	expert-peer dialogue	consequences, practical reasoning, values, best explanation, rules, classification	teaching/fostering tool (critical questions)
Metaxes et al. (2016)	primary	Mathematics	writing (assignment)	classroom discourse, research interview, writing assignment	teacher's argument quality
Nam & Chen (2017)	university	SSI	debate	causal, analogical, deductive, inductive, variables definition	argument analysis/assessment
Nussbaum & Edwards (2011)	middle	Social issues	oral & written discourse	consequences, practical reasoning, established rule, cause to effect, analogy, verbal classification, sign	teaching/fostering tool (critical questions) and argument analysis/assessment
Nussbaum et al. (2019); Nussbaum &y Putney (2020)	university	Social issue	oral & written discourse	argument from consequences	teaching/fostering tool (critical questions) and argument analysis/assessment
Ozdem et al. (2013)	university	Science	classroom discourse (inquiry-oriented laboratory sessions)	sign, correlation to cause, evidence to hypothesis	argument analysis/assessment
Rapanta & Macagno (2019)	university	Social science and humanities	academic writing	popularity, example, consequences, expert opinion, analogy, ignorance, practical classification, from value, cause-effect	argument analysis/assessment
Rapanta & Walton (2016a,b)	university	Social issues	writing (assignment)	Popularity, gradualism, consequences, ignorance, expert opinion, correlation to cause, generalization, analogy	argument analysis/assessment

Song & Ferretti (2013)	University	Social issues	writing (essays)	from consequences, from example	argument analysis/assessment
Wissinger & DeLa Paz (2016)	middle	History	writing (essay)	expert opinion, consequences	teaching/fostering tool (critical questions)

Figure 1. Overview of studies directly applying Walton's argumentation schemes in educational contexts from 2011 onwards

2.1. Science

Duschl (2007) was among the first educational researchers to take an explicit position in favour of the use of Walton's argumentation schemes as analytical tools in science education, also replacing TAP. The rationale behind this is that scientific discourse and reasoning is mainly rhetorical and dialectical (see also Ford 2008), and much less analytical; therefore, a tool that helps bring to surface the rhetorical and dialectical nature of students' arguments is necessary (see also Godden 2015). Although TAP implies arguments' rhetoricity and dialecticity (Nielsen 2013), it does not provide any additional help in making the reasoning behind the selection of certain elements and not others explicit (Hand et al. 2016). With argumentation schemes, this is possible: through the explicitation of premises that are the most adequate ones for a specific type of scheme, one can decide on the type of evidence that is most adequate for a specific type of scientific explanation. The TAP cannot provide any insight in whether the students' reasoning is acceptable or based on correct/incorrect premises. One can have a full structure with premises that are false, wrong, incomplete, or unrelated. In contrast, argumentation schemes allow distinguishing reasonable from unreasonable arguments—and detecting whether the students' reasoning follows from the premises (evidence) and whether the warrant used is complete, developed, or needs to be integrated and developed. In a sense, argumentation schemes introduce an assessment dimension, similar to the one present in a dialogue, which is missing from the Toulmin structure.

For example, if a student chooses to explain a scientific phenomenon using a cause to effect scheme, the most adequate evidence corresponds to the major and minor premises that accompany such scheme, namely: (a) the causal link (i.e., "generally, if A occurs, then B will occur"); and (b) the factual premise (i.e., A

occurs/might occur). In fact, among the empirical studies reviewed in science (see Figure 1), causal schemes (cause to effect, and correlation to cause), argument from sign/example, and analogy were the schemes that mostly emerged. Table 1 presents some reported students' examples from each one of these categories, and how they were identified and assessed by the studies' corresponding authors both in oral and written discourse.

Example of causal scheme (Konstantinidou and Macagno 2013)	*Original analysis*
[…] if the kids are on a beach and have brought the snow from another place, it does not matter whether they put a coat on the snowman, it will melt because the temperature outside does not allow the snowman to be frozen. […] If they put the coat on the snowman, it will make the snowman melt more quickly.	Factual premise: The external temperature is high and the snowman needs a low temperature Implicit causal link: *The coat increases the transfer of the high external temperature* Conclusion: The coat will make the snowman melt more quickly if the external temperature is high
Example of argument from sign (Ozdem et al. 2013)	*Original analysis*
Student A: So we will say that there was a linear relationship. Student B: I did a measurement: 100 g did not cause any change.	The argument was constructed during an experimentation task about Hooke's law, which was about the relationship between the force applied to a spring and its elongation. The measurement provided by Student B is a kind of observation (sign), which was used to refute the claim made by the opponent (Student A).
Example of argument from analogy (Lazarou, Sutherland, and Erduran 2016)	*Original analysis*
"The wall is a barrier. Mountain is a barrier. Therefore it is the same" (6^{th}-grade student)	Argument expressed by a student when discussing about whether we could produce echo in our classroom. It was recorded on the whiteboard to stimulate discussion among students.

Table 1. Examples of the most common schemes in students' arguments in science.

2.2. History

According to De La Paz and Wissinger (2017), Walton's et al. (2008) schemes provide a promising framework for analyzing primary and secondary sources and identifying aspects of text that reveal an author's point of view. Both these skills are strongly related to historical reasoning, and students' capacity to efficiently

structure essays on historical topics (more about the writing part will be explained in the next section). In fact, De La Paz et al. (2012) identified 22 different argumentation strategies manifested in schemes among secondary students' essays on two historical topics. However, only six of the strategies corresponding to a Walton et al.'s (2008) argumentation scheme were significantly related to students' ability, and these were largely different from topic to topic. These strategies were: verbal classification, example, consequence, and expert opinion for Topic 1; and commitment, expert opinion, and values for Topic 2 (only argument from expert opinion was applicable to both topics). De La Paz et al. (2012) also found that "good writers used three strategies in particular (argument from example, argument from consequence, and argument from expert opinion) not only to warrant their standpoints about both topics but also to frame their use of evidence" (p. 443). Table 2 presents a student's historical argument example given by De La Paz et al. (2012) with an analysis given by the author.

Student's example (De La Paz et al. 2012)	*Author's analysis*
Washington's main idea for conditions to become better would be for African Americans to earn their way into society. They would have "to make himself, through his skill, intelligence, and character . . . [a] value to the community." This at least states that blacks do have character, skill, and intelligence, but it also says how they still have to push their way into society. Washington also said that in order to earn respect African Americans should learn "to produce what other people wanted and must have." I think this is totally opposite in what ex-slaves wanted. They didn't want to have to work for their respect, they wanted to already have it and to fit into society as easily as possible. Since white people weren't going to give them respect as quickly and easily, why should they try hard to earn it?	This is an example of valid use of quotation as a premise to support one's own ideas, and not as a stand-alone self-contained evidence. One of the main errors of writing, even at university and above, is to use quotations without a further explanation or analysis of how such quotation serves as evidence for the writer's claims. This secondary school student manifests a correct use of argument from expert opinion, including a critique of this opinion at several points, also revealing some degree of inconsistency in the expert's, in this case George Washington's discourse. It is clear that the student applies critical questions as an implicit strategy towards organising his/her writing as a critical argumentative essay, rather than simply informing about Washington's ideas.

Table 2. Student's historical argument analysed using Walton's argumentation schemes.

2.3. Social issues

When it comes to analysing students' reasoning about social issues, i.e., issues of a common interest for the general public, the theory of paraschemes proposed by Walton (2010) is of great use. As social issue discussion does not have any particular disciplinary context to which it relates, and personal arguments may commonly emerge, Rapanta and Walton (2016a; 2016b) propose a method of identifying students' less valid argumentation schemes (i.e., paraschemes), as they emerge in an argument diagramming exercise of university students. Paraschemes represent speedy forms of inference that instinctively jump to a conclusion, without weighing the most relevant available information first. An analyst may decide whether an argument meets the minimum plausibility criteria in order to be sound or not, by first identifying which is the type of argumentation scheme most related to the argument produced, and second, by asking the critical questions accompanying it. As most everyday arguments are uttered enthymematically, i.e., without all the premises made explicit, the satisfaction or not of the critical questions matching each argument/scheme may be limited to those questions directly relating to acceptability and sufficiency of the premises, necessary for an argument to be minimally plausible and sound. These standard criteria of soundness/plausibility are, according to Voss et al.: "1) the acceptability or plausibility of the reason per se; 2) the relevance or support that the reason provides for the claim; and 3) the extent to which counterarguments are taken into account" (1993 p. 166). Translating these criteria into critical questions, the analyst may take the decision upon whether an argument corresponds to a valid argumentation scheme or a parascheme by asking about: 1) the relation between the major premise and the conclusion, i.e., how relevant the major premise is to support the conclusion; 2) the sufficiency of the support provided to sustain the plausibility of the conclusion; and 3) the weighing/consideration of other alternative premises that may lead to a different conclusion.

For example, the inference represented as "if *p* is an expert opinion, *p* should be accepted" is a paraschematic version of the complete argument from expert opinion, and it corresponds to the *ad verecundiam* fallacy. In natural language, this non-valid argument (parascheme) would be: "An expert E says that A is true in

their domain of expertise. Therefore, A is true." The critical questions that fail to be answered in this case are: 1) Is E an expert in the field that A is in? 2) What did E assert that implies A? 3) Is E's assertion based on evidence other than his/her assertion itself? A complete list of the main informal argumentation schemes and their corresponding paraschematic versions can be found in Rapanta and Walton (2016b; p. 215). The same method of fallacy identification using the heuristic forms of argumentation schemes was also used by Rapanta and Macagno (2019) in their analysis of academic writing texts written by post-graduate students in Social Sciences and Humanities. Table 3 shows an excerpt of an essay, part of that study, analysed using paraschemes. The first example is located in the introduction of the essay, whereas the second example refers to the identification of a gap in the existing literature.

Students' examples (Rapanta and Macagno 2019)	*Author's analysis*
In 2015, I carried out historical research in film archives about the working relationship between talent agents and independent actors in 1930s in Hollywood. I used primary sources (agents', producers', and actors' private collections) and secondary sources (film history books, autobiographies, and biographies) for the research. From this experience *I noticed* a lack of exhaustive information on the historical period that I was studying.	*Ad verecundiam*: The author defines herself as an authority when she states that a gap in the research field she is interested in was there because she had noticed it, without justifying with what methods the gap was identified and whether other more recognised sources than herself also recognize this gap.
Most film history books focus on the star system and the industrialization of cinema; *few of them* focus on the history of the actors' union fights that tied down actors and stars throughout the 1930s, and only *few researchers* mentioned the presence of talent agents in Hollywood.	*Ad ignorantiam*: The author refers to the lack of history book sources focusing on 1930's Hollywood film business. Her claim that this lack is a sufficient premise for a research study to be done on this topic is not persuasive, as several other factors need to be considered (e.g., why other history authors have neglected this aspect, why it is relevant to address it, etc.).

Table 3. Examples of paraschemes emerged in academic writing essay drafts.

In conclusion, Walton's (1996) and Walton et al.'s (2008) argumentation schemes have been recognized by education researchers as useful tools for analysing students' arguments in different disciplinary fields and grades. This recognition has many times been

accompanied by a comparison to the highly used but perhaps not-as-successful adaptation of TAP to educational contexts. For example, Hand et al. (2016) argue that the passage from "a strict Toulminian perspective toward the dialogic illustration of argument championed by Walton" is crucial as it is "one that opens the door to adaptive pedagogy" (p. 226). In addition, many scholars have used the two approaches in combination (e.g. Abi-El-Mona and Abd-El-Khalick, 2006; Basel et al., 2013; Jiménez-Aleixandre and Pereiro-Muñoz, 2002), whereas a recent paper (Macagno and Rapanta 2019) presents an integrated framework combining Walton, Toulmin, and Deanna Kuhn, a prominent educational researcher, as a method for analysing and assessing students' arguments. However, what makes Walton's approach unique is the inclusion of critical questions as a necessary condition for an argumentation scheme to be valid. Al- though his theory of paraschemes as analytical tools has not yet received much attention by educational researchers, the use of critical questions as a method of fostering the emergence of valid argumentation schemes in students' writing has been broadly used as I will show in the next section.

3. Walton's critical questions as a tool for fostering students' argumentative reasoning skills

Since Socratic times, questioning has been an important pedagogical tool, as it allows learners to make their reasoning explicit, and advance their knowledge, by "filling in" the gaps between prior and new knowledge. Moreover, questioning the evidence for a claim, as is the case for Walton's critical questions, is considered an essential aspect of scientific literacy (Roberts and Gott 2010), defined as the ability to combine knowledge, values and actions about topics requiring some disciplinary knowledge in order to be sufficiently addressed (Kolstø 2001).

Nussbaum (Nussbaum and Edwards 2011; Nussbaum and Putney 2020; Nussbaum et al. 2019) was one of the first educational researchers who saw the value of Walton's critical questions as a scaffolding tool for students' writing about social (i.e., general interest) topics. Based on the positive results obtained by Nussbaum and Schraw (2007), who fostered university students' argument-counterargument integration strategies in writing essays using a

simple graphic organizer, Nussbaum (2008) proposed the Argumentation Vee Diagram (AVD) which explicitly focuses on the integration between arguments and counterarguments. The reasoning behind this idea is that the skill of arguing is at least a three-fold skill, namely: constructing cogent arguments, constructing cogent counterarguments, and generating rebuttals to those counterarguments (Kuhn 1991; Nussbaum 2021). Nussbaum (2008) combined the AVD tool with two main critical questions to facilitate students' argument-counterargument integration strategies, corresponding to the rebuttal skill. These critical questions were: "Which side is stronger, and why?" and "Is there a compromise or creative solution?" In a subsequent study, Nussbaum and Edwards (2011) further elaborated the critical question prompts by introducing a table with a list of schemes-related critical questions on one part and a checklist for each one of the sides on the other (p. 460). This visualization, which allowed for a guided weighing of the two sides' arguments, led to the manifestation of different types of integration strategies, such as synthesis, weighing, refutation. Pseudo-integration strategies were also present in students' essays, such as restatement and amplification of the side or argument that the student considered as the strongest.

Walton's critical questions have been used also in other contexts, not only related to writing. For example, Macagno, Mayweg-Paus, and Kuhn (2015) describe the function of a dialogical move aiming at undermining the opponent's position through the use of critical questions. These moves, called 'undercutters', being attacks against the inferential link between premises and conclusion, question or reject the premises that support the opponent's conclusion by supporting their falsity or asking critical questions. Table 4 shows an excerpt from a dialogue between a middle-grade student and an 'expert' adult in which several types of undercutters based on critical questions emerged.

Line	Speaker	Speech	Analysis
1	Student	Isn't there a way to settle their problems or concerns?	Practical reasoning
2	Expert	I don't know—but if all the school is doing is giving them warnings, then they haven't tried.	Argument from example undercutter
3	Student	What if they had tried, but they thought that misbehaving was the better path to take?	Argument from example undercutter
4	Expert	Even so, the school should not give up on the kids, they should find a way to work with them. To expel them is to turn their back on them and say: "now you're someone else's problem".	Argument from values undercutter
5	Student	What if the school tried, but they weren't successful?	Argument from example undercutter

Table 4. Critical questions used as undercutters (the dialogue excerpt is from Macagno et al. 2015).

As seen in the example above, taken from a dialogue on the topic of expelling disturbing students from school, the expert (i.e., an adult trained on using dialectical moves) replies to the student's practical reasoning scheme by an argument from example that serves as an undercutter (Line 2) to the student's proposal (Line 1). Then the student replies with another undercutter that also used argument from example (Line 3). The expert continues with a different scheme (argument from values) undercutter on Line 4, giving place to the student's second spontaneous undercutter on Line 5. Two things are further worthy of our attention here: first, the expert uses undercutters corresponding to a variety of argument schemes, whereas the non-expert student does not (this is more visible from the whole excerpt found in Macagno et al. 2015, p. 532); second, the critical questions used as undercutters by the expert have a modelling effect on similar strategies gradually appropriated by the student. The fact that teachers' dialogue moves, and in particular questions, have a modelling effect on students' dialogical behaviour, i.e., the fact that they affect the degree and way students use similar discursive strategies, is confirmed by extensive educational research literature (e.g., Chen, Hand and Norton-Meier 2017; Dawson and Venville 2010; Murphy et al. 2018; Simon, Erduran and Osborne 2006). What Walton et al.'s (2008) critical questions and their use in educational contexts also bring is their dialogical and dialectical relevance. Dialogue moves efficiently applying critical questions

are relevant to the previous dialogue moves in the sense that they help the dialogue move forward. In addition, their direct relation to a valid argumentation scheme gives them a significant dialectical potential as they aim at revealing the logical relation between the argument premises, therefore they are logically more complete. For example, the student in Line 3 of the example above (Table 4) instead of simply saying "What if they had tried?", (s)he says "What if they had tried, but they thought that misbehaving was the better path to take?"

Overall, Walton's critical questions have been quite often used in educational research, especially as a scaffolding method for students' argumentative, two-sided writing integrating arguments in favour and against a position. More research is necessary to explore the potential of critical questions in classroom dialogue settings, as compared for example to other types of questions that miss this critical component.

4. Walton's types of dialogue and their influence in educational research

Walton's theory of argumentation schemes and critical questions is only a part of his dialogue theory, the other part being the types of dialogical contexts in which such schemes and questions may emerge. Walton (2013) describes at least seven types of dialogue contexts with an argumentative potential: information seeking, inquiry, negotiation, discovery, persuasion, deliberation, and eristic dialogue. Each one of these has a starting point, functioning as a necessary condition for the dialogue to take place, participants' shared dialogue goal being pursued during the dialogue, and participants' individual dialogue aims fitting together in the shared goal (see Table 5). This normativity, expected in a theory-driven approach such as Walton's dialogue theory, is not restrictive at the time of implementing these types of dialogue as analytical tools in classroom discourse. Their flexibility lies in the fact they are frameworks for describing possible argumentative dialogues, through the application of some normative criteria, as, for example, the participants' implied shared goal; they are not prescribing an optimum model of dialogue, as for example the Critical Discussion dialogue

model offered by the Pragma-dialectical approach (van Eemeren and Grootendorst 2003).

TYPE OF DIALOGUE	INITIAL SITUATION	PARTICIPANT'S GOAL	GOAL OF DIALOGUE
Persuasion	Conflict of Opinions	Persuade Other Party	Resolve Issue
Inquiry	Need to Have Proof	Verify Evidence	Prove Hypothesis
Discovery	Need an Explanation	Find a Hypothesis	Support Hypothesis
Negotiation	Conflict of Interests	Get What You Want	Settle Issue
Information	Need Information	Acquire Information	Exchange Information
Deliberation	Practical Choice	Fit Goals and Actions	Decide What to Do
Eristic	Personal Conflict	Hit Out at Opponent	Reveal Deep Conflict

Table 5. The seven types of dialogue proposed by Walton (2013).

Various educational researchers refer to one or more of Walton's types of dialogues as a framework to describe what classroom argumentation dialogue is ideally about. This educational ideal perspective does not imply any idealistic model of dialogue; it simply refers to the educational ideal of applying the two main aspects of critical thinking, namely persuasive argument and inquiry (Kuhn 2019). In fact, Walton's description of a persuasion dialogue (Walton 2008; 1999) has been used as the basis for educational interventions explicitly using disagreement as the basis for putting forward one's one views while at the same time undermining those of the other party. Other scholars (Reznitskaya and Gregory 2013; Wilkinson et al. 2017) have suggested inquiry as the dialogue framework that best describes what takes place in an argument-based classroom where the goal is to search collectively for the most reasonable answer or answers to an open problem. Recent research (Felton et al. 2019) focuses on Walton's deliberation (Walton 2010a; Walton, Toniolo, and Norman 2016) as a framework of productive dialogical argumentation, in which participants seek to resolve an apparent or real discrepancy in their views "to reach an optimal, nuanced, robust or complex decision about a course of action" (Felton et al. 2019, p. 2).

All the above examples view Walton's dialogue types as a general framework for a dialogue to take place in. They view participants' goals as being the same during a whole episode of interaction, as in the case of peer-to-peer deliberative dialogues, or even during a whole type of activity, as in the case of inquiry-oriented dialogic teaching. In other words, I argue that the view currently implied by educational researchers in view of Walton's dialogue goals reflects the *instructional framing* approach (Ford and Wargo 2011; González-Howard and McNeill 2018; Schwarz and Baker 2017) adopted by researchers in the field of argumentation and education, rather than the *actual progress* of a situated learning dialogue. In particular, the views described above by Deanna Kuhn, Alina Reznitskaya and Mark Felton correspond to three different types of instructional framings of argumentative dialogue, namely: (a) an argument-as-persuasion framing, where dyadic peer-to-peer interaction is necessary to choose the best explanation among two contradictory ones; (b) an argument-as-inquiry framing, in which several perspectives about an open problem can be simultaneously valid especially in a whole-class format; and (c) an argument-as-deliberation framing, in which a decision about a particular problem needs to be taken by means of small-group discussion, even if this decision corresponds to agree to disagree.

Another way of looking at Walton's types of dialogue is at a sequence level. This view implies that participants engaging in a dialogic activity can shift from goal to goal during the whole course of activity. In a classroom context, this view implies that dialogue is seen as a bottom-up emerging activity, open to all different possibilities, which sometimes are also different from the main possibility that frames teachers' and students' epistemic interactions, as the ones previously described. This view, recently showcased by Rapanta and Christodoulou (2019), is more pragmatic, in the sense of describing the continuous, dynamic interaction between meaning (discourse) and context (dialogue goal). It further implies the importance of individual dialogue moves, made by either the teacher or the students, which can be crucial in marking a shift in the type of dialogic sequence participants are engaged with. Such "fluid and subtle shifts" (O'Connor and Michaels 1996) are necessary for the creation of new, more productive participation structures (Engle

2006; González-Howard and McNeill 2018). In addition, when the shift is marked by the teacher, it is also common that a better alignment with the academic tasks and goals is achieved. For example, O'Connor and Michaels (1993) describe how a Maths teacher named Lynne transforms what would typically be an information-seeking dialogue, i.e., students sharing their own solutions with each other, into an inquiry dialogue, aimed at identifying the best explained solution of the given problem. She does this using the strategy of revoicing students' contributions, while reinforcing and reformulating their evidential support.

In conclusion, Walton's types of dialogue have influenced the way educational researchers look at classroom dialogue and discourse, but to a more limited degree than argumentation schemes have done. In particular, the interaction between schemes and dialogue type identified at a sequence level, which is already studied in fields rather than education (see, for example Macagno and Bigi's 2017 study in the field of medical communication), is open to further research. This pragmatic interaction between what participants say and how this contributes to their shared goal in dialogue can also give place to the identification of missed opportunities or affordances (Rapanta and Christodoulou 2019). These missed opportunities often refer to students' moves with a dialogic and dialectical potential (e.g., shifting the flow of dialogue from one type to another) which end up being ignored by the teachers because of lack of time, or lack of ability to orchestrate productive whole-class discussions (Clarke et al. 2016). Some other times missed opportunities include teachers' efforts to shift to a more epistemically requiring type of dialogue (e.g., discovery, persuasion) without students sufficiently contributing to those efforts, therefore without evidence of a mutually pursued shared goal (Walton and Macagno 2016). Recognizing opportunities for shifting to a more productive type of frame of dialogue, eliciting co-construction of contents and meanings among students and between students and the teacher, is an open challenge for teacher professional development in the field of dialogic and argument-based teaching (Sedova, Sedlacek and Svaricek 2016; Wilkinson et al. 2017).

5. Open paths for future research

Although argumentation schemes, critical questions, and dialogue types have influenced educational researchers, other aspects in Douglas Walton's theory with a potential for education have not yet been exploited as much. Below I will refer to some of them.

5.1. Defining an argument – argument vs explanation

In his seminal work titled "What is reasoning? What is argument?" Walton (1990) establishes a distinction between what can be defined as reasoning or inference, and argument. In his view, reasoning is "the making or granting of assumptions called premises (starting points) and the process of moving toward conclusions (end points) from these assumptions by means of warrants" (Walton 1990, p. 403); whereas argument is "a social and verbal means of trying to resolve, or at least to contend with, a conflict or difference that has arisen or exists between two (or more) parties" (Walton 1990, p. 411). An argument includes reasoning, but reasoning can take place in other contexts rather than argument. For instance, critical thinking assessment tests require the manifestation of several types of reasoning skills, but do not include a full manifestation of argument skills, as the social (real, as in argumentative dialogue, or implicit, as in argumentative writing) aspect of argumentation is missing.

The distinction between reasoning and argument is also important for another reason, of high significance for educators, which is the place of explanation in classroom discourse (both oral and written). If reasoning highly corresponds to the passage from one set of premises to another by means of a warrant (i.e., an inferential link between the conclusion and the premises), then it is easy to understand why a great part of reasoning inferences are explanatory inferences, mainly of a causal nature. And if explanations are conceived as assignments of causal responsibilities (Josephson and Josephson 1996) then argument is the logical tool with which we decide the plausibility and strength of those responsibilities. For example, in science, an explanation can correspond to the formulation of a hypothesis (e.g., objects fall because of gravity), but then we need evidence to support this explanation or not (Berland and

McNeill 2012; see also Bex and Walton 2016, for a view on how arguments are used to support explanations). Similarly, in history, an evidence can be used as the one that best explains a historical incident, for example a quotation from a significant document, but then we need explanation to support how and why this evidence works in service of our argument. In conclusion, argument and explanation are complementary (Osborne and Patterson 2011), but in no way can an explanation alone function as evidence for an argument claim as described in the next section.

5.2. Defining evidence

The distinction between argument and explanation is an important one when it comes to defining what is evidence and how to teach students about it (McNeill 2011). In education, the term 'evidence' is quite ill-defined, also because in different fields/topics of discussion, different things may count as evidence. For instance, in science, the majority of arguments are "warrant-establishing" (Toulmin 1958) in the sense that the warrant, not the conclusion, is novel, and put forward to open discussion. In other words, the element of risk inherent in an argument lies in the warrant, but the burden of proof, upon which it is decided whether the warrant is an acceptable truth or not, lies in the backing. In history, where the majority of arguments are "warrant-using" (Toulmin 1958), the element of risk lies in the data used to support a claim, but the burden of proof, upon which it is decided whether the data is acceptable to support a specific claim or not, lies in the warrant. Therefore, it can be said that in the science case, warrants serve as explanations, which are open to discussion and therefore need evidence (backing) to be supported; while in the history case, data serve as explanations, which are open to discussion and therefore need evidence (warrant and backings) to be supported. Table 6 shows an example of each (see also Rapanta 2019a).

	Warrant-establishing argument in science	Warrant-using argument in history
claim	It is possible to make ice cream that doesn't melt.	Neanderthals were much more sophisticated than is popularly believed.
data	By adding a protein present in Japanese fermented soybeans called "natto".	*Paintings found in three Spanish caves are over 64,000 years old.*
warrant	*This protein was found to fix together fat, water, and air in the ice cream.*	That's 20,000 years before the first humans arrived in Europe.
backing	Experiments by Scottish scientists showed that by adding this protein, ice cream is maintained solid for a longer time.	The team behind this study used the uranium-thorium method to date tiny carbonate deposits that have built up on top of the cave paintings.

Table 6. Examples of warrant-establishing and warrant-using arguments.

As can be seen in Table 6, in the science case the claim and data together count as an explanation, as it cannot be subject to doubt (the syllogism of the 'if x, then y' type applies), and the part of the argument that is subject to doubt and calls for evidence is the warrant. However, in the history case, the warrant, which in that case corresponds to a generally accepted truth, serves as an explanation, which fills the gap between the claim and the data. The part that is mostly subject to doubt here is the claim, which seems to be unrelated to the data before the warrant becomes explicit. The warrant here becomes the explanation, and the data is further supported by the backing. In both cases, the evidence corresponds to the backing; however, what counts as an explanation, is located in different elements of the argument. In warrant-establishing arguments, the backing-evidence supports the warrant, which supports the claim-data relation, whereas in warrant-using arguments, the backing-evidence supports the data through the warrant.

Why does this distinction matter and how does it relate to Walton' theory? It matters because different argument elements must be present (explicit) for an argument to make sense in one case or another, and it is those necessarily present elements that are open to be challenged, therefore calling for critical questions to be asked. In the above example, for the science case, the data is less important than the warrant, and the warrant needs to be made explicit before the backing. However, for the history case, the warrant is less important than the data and it only needs to be made explicit in case the backing is not considered sufficient. In the first case, critical questions are expected to focus on the backing-warrant relation (for example, what about other proteins? What happens with temperature change? etc.). In the second case, critical questions are expected to focus on the claim-data relation (for example, what does this finding tell us about humans' history? how can the paintings' age be defined? etc.).

The above can have significant influences both for the designing of argument-based learning environments, both with and without computer support, in which critical questions have a central place, as well for the development of artificial intelligence argument analytical tools. Regarding the latter, locating *where* (i.e., data, warrant, backing) within the argument logical structure arguers' fallacious use of premises takes place can be of great help for education and AI researchers alike (see Rapanta and Walton 2016b, for a step towards this direction).

5.3. Argument diagramming for collaboration

Argument diagramming tools such as argument maps enable participants in argumentation to not only maintain arguments and counterarguments in working memory, but also to organize their thoughts in approaching the problem of how to evaluate the arguments. Therefore, their use as scaffolding tools in real-time computer-supported collaborative argumentation is of great value, as extensive research in education has shown (e.g. Andriessen and Baker 2013; Muller-Mirza et al. 2007).

One of the least known contributions of Douglas Walton, at least within educational research, is his construction of a computer-supported argument mapping software called Carneades (Walton and

Gordon 2012). Its innovative aspect as compared to other argument diagramming tools is the fact that it can handle the critical questions matching an argumentation scheme, representing therefore the evidentiary structure of reasoning in a more explicit and manageable way. Although a formal system such as Carneades allows argumentation to be analyzed at a greater depth, Walton (personal communication[1]) himself does not consider this and other graphical tools to be necessary for representing the structure of an argument. However, being able to integrate such an advanced artificial intelligence method of integrating critical questions in arguments' evaluation with a computer-supported argumentative dialogue interface is a promising future direction for educational researchers working in that field.

Another way of combining artificial intelligence with education based on Walton's dialogue theory is the one proposed by Wecker and Fischer (2014, p. 226). According to these authors, a taxonomy synthesizing different relevant aspects related to the quantity and quality of students' arguments in comparable computer-supported collaborative learning situations could be very helpful at the time of scripting dialogue occurring within them. Walton et al.'s (2008) schemes, these authors argue, should form part of such a taxonomy as they can help identify the occurrence and number of different types of arguments.

An additional contribution regarding the use of argument diagramming tools, such as Carneades, as a way of visualizing and scaffolding real-time interaction is the assessment of the logical relation—'local' relevance (Walton 1989) among argument elements, but also of the different claims between them—consistency (Montanari 2019). More work towards this direction is necessary, also in light of recent advances in automatized argument mining tools (see Walton and Gordon 2019, for a review).

[1] Back in 2015, Douglas Walton shared with me by e-mail his thought that we do not need any automated tools to make a useful argument diagram. We can use a pencil and paper, and this method can often be a useful first step before using one of these systems to make a more refined and pleasing version of the diagram.

5.4. Social epistemology

Another less investigated aspect of Walton' theory is his defeasible conception of knowledge (Walton 2005), characterized by three principles: (a) knowledge, as something being collected during a process of inquiry, is always open to retraction; (b) a knowledge base can be incomplete or even closed-off due to reasons irrelevant to the inquiry itself (e.g., lack of funds to continue an investigation, death of the principal investigator, etc.); (c) a knowledge base can be fallible and it is always possible to be reopened as new evidential facts need to be considered. This approach of knowledge and knowledge base construction is very important as it defines when and how factual information becomes knowledge, and a piece of knowledge becomes evidence. This view also represents a social epistemology, "because the process of presenting and criticizing the evidence collected at any given point in the sequence of argumentation requires an exchange of views between pro and contra sides" (Walton and Zhang 2013; p. 179).

The above view is highly meaningful for education researchers and practitioners for at least two reasons. First, it provides a defeasible view not only of evidence (i.e., a piece of knowledge decided to have evidentiary power at a certain moment of inquiry/argumentation), but also of expertise as different sources can be decided to be in position to know during different stages of the investigation. This view is necessary for redefining pedagogical dialogue from a one-way monological interaction to an authentic multi-party dialogue with students' epistemic agency being constantly and dynamically promoted (see also Lai and Campbell 2018; Rapanta 2019b). Second, it contributes to the operationalization and promotion of critical thinking not as an abstract ill-defined concept but as the manifestation and implementation of concrete skills that regard the identification, comparison and use of a concrete piece of information as evidence to support a claim put forward in a specific dialogical context (Kuhn 2019). Third, as other epistemological skills, argument-related socio-epistemological awareness is understood as a transferrable competence, therefore it is justified why learning to argue in a specific dialogic context is transferred to other (types of)

contexts (for example from oral to written argumentation or from one topic to another—see Iordanou and Rapanta 2021).

6. Conclusion

The goal of this review article was to provide a qualitative synthesis of empirical and theoretical research applying and advancing Douglas Walton's contributions in the field of education. The two fields of argumentation theory, on one hand, and educational research, on the other, have often advanced separately without one informing the other, therefore often rendering argumentation and education applications theoretically weak (Rapanta and Macagno 2016). Douglas Walton's theoretical contributions in the argumentation field, such as the argumentation schemes, the critical questions, and the types of argument dialogues, have been proven "handy" tools for educational research to use, as the overview presented above showed. Moreover, other aspects of Douglas Walton's theory such as the relation between argument and explanation and the use of argument diagramming and assessing tools for collaborative learning have attracted less attention by educational researchers, therefore calling for more in-depth explorations in the future. The roadmap provided in this review of more or less explored aspects of Douglas Walton's contributions in educational research is meant to guide more theoretically reliable advances in the growing interdisciplinary field of argumentation and education.

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