Argumentation Theory in Education Studies: Coding and Improving Students' Argumentative Strategies

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Abstract This paper is aimed at combining the advances in argumentation theory with the models used in the field of education to address the issue of improving students' argumentative behavior by interacting with an expert. The concept of deeper or more sophisticated argumentative strategy is theoretically defined and used to advance two new coding schemes, based on the advances in the argumentation studies and aimed at capturing the dialectical, or structural, behavior, and the argumentative content of each dialogue unit. These coding schemes are then applied for a qualitative analysis of a study designed to investigate how students' argumentative behavior can be influenced by the interaction with an expert, who used specific types of attacks to the interlocutors' positions. The twofold coding shows at which dialogical level expert–peer interactions can directly and more stably affect students' argumentative behavior, and what effects such more sophisticated strategies can have on the discussion and the analysis of disagreements. In particular, this paper shows how a specific type of deep-level attack, the underminer, can open dialogues of a different level, focused on unveiling and debating background beliefs underlying a specific position.

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The advances in the field of argumentation theory and the research in the area of education are increasingly becoming interconnected (Mirza Muller and Perret-Clermont 2009). On the one hand, education is the natural and traditional application of argumentation studies. Since Plato's times, dialogue and dialectical reasoning have been regarded as crucial components of education. In the Middle Ages (Kretzmann et al. 1982), dialectics was together with grammar (linguistics) and rhetoric the ground of academic teaching, and argumentative tools (such as commonplaces, strategies and patterns of reasoning) were used as instruments for teaching and learning, and as part of the method for supporting philosophical theses. On the other hand, interest in argumentation studies is constantly increasing in the field of education. Argumentative, collaborative dialogues have been shown to be an extremely effective teaching strategy (Murray 1982; Glachan and Light 1982; Alexopoulou and Driver 1996; Baker 1999; Driver et al. 2000; Nussbaum 2008a, b) both for improving students' critical skills (see Pera and Sahea 1991; Koballa 1992; Osborne 2010) and addressing background knowledge (Jucks and Paus 2013; Paus and Jucks 2012; Hewson 1992; Limón 2001), including misconceptions and the roots of deep disagreements. This principle is at the basis of the idea of science as an argument, i.e. the view that science education should address "the appropriation of scientific discourse", constructing students' knowledge through argumentative interactions (Kuhn 1991, 1993, 2010; Garcia-Mila et al. 2013). Through the use of arguments, students have been shown to acquire not only the knowledge of scientific concepts, but the grounds on which such concepts are based (McNeill and Krajcik 2008;

Sandoval and Millwood 2005), revising their prior knowledge (Cross et al. 2008).

This paper is principally aimed at addressing the problem of providing a methodological tool for analyzing students' arguments, and detecting what can count as a better or more sophisticated argumentative strategy (Erduran 2007). By developing a coding system that captures from both a dialectical and content point of view the nature of an argumentative move, it is possible then to design and propose possible empirical activities aimed at improving students' argumentative skills. Our theoretical proposal is based on the combination of the two distinct traditions of argumentation studies and educational research. Insights provided by recent works in the field of argumentation have been used to design, code, and analyze an empirical study whose purpose is to assess qualitatively how students' argumentative skills can be influenced through an expert–peer interaction in which the expert used specific strategies. The theoretical argumentative background provided the framework for selecting the argumentative strategies that directly affect the interlocutors' replies.

In order to understand the argumentative effects of expert–peer interactions, we have designed two distinct coding systems, one aimed at capturing the dialectical structure of the argumentative dialogue, and the other focused on the content of each dialogical move. In the first case, we combined a functional coding scheme developed in the field of education (Kuhn and Udell 2003 and Nussbaum and Schraw 2007) with the dialectical principles pointed out in argumentation studies (Walton et al. 2008; Walton and Krabbe 1995; Krabbe 2003). The content level of the moves was coded based on the types of argument described in the argumentation scheme approach (Walton, Reed and Macagno 2008), which can be considered as a further development of Toulmin's argument pattern. The use of this twofold coding framework is aimed at (1) examining qualitatively at which level a specific dialectical behavior adopted by the expert can lead the student to modifying his behavior, and (2) describing how such more sophisticated argumentative behavior can unveil deeper misunderstandings or disagreements. This structural and content analysis reveals how students can be led, by means of specific types of attacks, to engaging in dialogues of a deeper level, also called metadialogues, aimed at bringing to light the background beliefs underlying a specific position or claim (Leitão 2000; Nussbaum 2008b).

1 Dialogues, Argumentative Behavior, and Background Knowledge

Argumentation is a dialogical activity grounded on two crucial principles, i.e. common beliefs and defeasibility.

Arguments are based on premises that are not necessary, but only commonly shared, such as values, presumptive causal relations, or commonly accepted definitions. Given the endoxical nature of their premises, arguments are inherently defeasible, i.e. subject to default should one of the premises be challenged or refuted (Nussbaum and Edwards 2011: 444). The essential relationship between background beliefs and arguments, and the defeasible nature of argumentative reasoning make argumentation an activity of fundamental importance for unveiling and addressing background knowledge and misconceptions.

The crucial role of argumentation in teaching has been underscored in many studies (see Pera and Sahea 1991; Osborne et al. 2004; Koballa 1992; Sandoval and Millwood 2005). Teaching can be considered as an argumentative dialogue as its basic purpose is to modify and develop the students' "private understanding," showing the limits thereof and building on it in order to account for new phenomena (Simons et al. 2001: 7; Chi and Roscoe 2002). One of the crucial instruments used for achieving such a goal is the use of arguments. Students' arguments can be encouraged in order to bring to light the background beliefs on which they are based. Such arguments and the underlying background knowledge can become the issue of further argumentative moves, directed to providing reasons showing their incompleteness and supporting the scientific viewpoint. For this reason, argumentation tools are fundamental for both enhancing the students' critical thinking skills, and improving classroom interactions, so that students' prior beliefs can be better made explicit, addressed, and developed (Osborne et al. 2004: 995; Carey 2000: 13–14). The advances in argumentation theory can provide useful resources for improving argumentation in classroom interactions, by taking into account both the argumentative dialogical models (van Eemeren and Grootendorst 1984, 1992, 2004; Walton 1984; Walton and Krabbe 1995) and the argument structure (Walton et al. 2008).

These two dimensions of argumentative dialogue, i.e. the dialogue and the argument structure, can reveal distinct and interdependent aspects of argumentative behavior. On the one hand, the analysis of the different dialogical moves, i.e. speech acts aimed at a specific dialogical purpose (such as countering the interlocutor's argument or advancing a viewpoint) can show the macro-structure of the speakers' dialectical attitude. This analysis can mirror what type of argumentative discussion the interlocutors are engaged in, whether it is more focused on the opposition of incompatible positions (consisting in more frequent use of direct attacks), the search for an alternative and potentially acceptable viewpoint (corresponding to a more frequent use of arguments supporting an alternative conclusion), or on the investigation of the deep reasons supporting a certain standpoint (i.e. a more frequent use of undercutters).

On the other hand, the argument structure can bring to light the distinct perspectives under which the issue under discussion and the interlocutors' viewpoints (Walton 2006) are taken into account for supporting a conclusion. The same issue (such as military intervention) can be regarded under distinct complementary respects for the purpose of bearing out a certain position. For example, the same state of affairs can be taken into consideration from the point of view of its positive or negative consequences, or the values and rules that it involves, or the reasons that brought it about, or the way in which it can be classified and judged.

The two distinct types of analysis, focused on the two components of the argumentative behavior, i.e. the dialectical moves and the argument types, can shed light on the goal (and quality) of the students' dialogues. A difference of opinion can be resolved by reaching an agreement on a viewpoint, which can correspond to the one defended by one of the parties or a new position encompassing the two opposing views. In both cases, at least one party needs to modify his attitude towards his viewpoint. In the first case, "one party has to be convinced by the argumentation of the other party of the admissibility of that party's standpoint" (stronger condition) or the other party has to retract "his standpoint because he realizes that his argument cannot stand up to the criticism" (weaker condition) (Van Eemeren and Grootendorst 2004: 58). This latter option opens up the possibility of accepting the interlocutor's or an alternative point of view. Dialogues, in order to be considered as closer to an ideal model of dialogical rationality (see for instance Van Eemeren and Grootendorst 1984, 1992, 2004), need to address the origin (or cause) of the disagreement by investigating the values and the classifications underlying the opposing positions. In this fashion it is possible to avoid pseudo-agreement or pseudo-disagreements (Naess 1966: 92–93) and direct the discussion to the "facts" (i.e. the subject matter that is controversial) and not merely to the words used (Aristotle, *Topics* 108a18–108a36).

The distinction between dialogues focused on the standpoints and the ones aimed at unveiling the deeper cause of disagreements is mirrored by the theoretical difference between the dialogical and meta-dialogical levels of dialogue (Krabbe 2003, 2007). The first level consists in moves directed at attacking the interlocutor's viewpoint by opposing a contrary or an alternative viewpoint, which in turn needs to be defended when attacked. The second level can be described as a dialogue on the conditions of a dialogue, or a discussion on the grounds of a difference of opinions. The speaker challenges the possibility of a dialogue move, which in case of arguments amounts to the relationship between the premises and the conclusion. In other words, he challenges the fact that a premise can bear out the wanted conclusion because based on starting points

that are unaccepted by or unacceptable for the hearer. For this reason, meta-dialogues usually bring to light a deeper dimension of a disagreement (Turner 2006; Fogelin 2005; Finocchiaro 2012: 40), consisting in conflicts of classifications, definitions, and values. Even though there is no correlation between a meta-dialogue and a specific argument type (dialogue and meta-dialogues can consist of different kinds of argument), the use of certain types of argument can reveal a specific way to address deep disagreements. For instance, a higher use of reasoning from classification shows the need of analyzing in depth a concept or the interpretation of a state of affairs (Chi 2005). Conceptual representations of words that represent central aspects of a learning topic can be highly different between learners (Paus and Jucks 2011; Jucks and Paus 2012). Resolving such differences during discussion results in deeper elaboration of the underlying conceptualization and is shown to have a pivotal influence on conceptual learning (Paus and Jucks 2012; Paus et al. 2012; Jucks and Paus 2013).

2 Analyzing and Developing Argumentative Behavior

The evaluation of argumentative behavior based on the dialectical level of argument questioning and attack constitutes the ground for advancing a method for improving learners' argumentation quality by designing students' discussions, which include the use of deeper dialectical moves. This proposal is grounded on two distinct approaches to dialogue and argumentation, i.e. empirical educational research and theoretical argumentative models.

In education, models have been developed to improve students' reasoning and argumentative competence by teaching argumentative skills (Zohar and Nemet 2002) and guiding and modeling discussions among peers and between experts and students. Peer–peer discussions are directed in particular to improve collaborative reasoning (Clark et al. 2003; Andriessen 2006; Kuhn et al. 1997). Cognitive conflicts to be solved by discussants stimulate students' argumentation, consisting not only in the production of arguments, but also in the evaluation, questioning, and countering thereof. In particular, in Anderson et al. (2001) and Kim et al. (2007) it was shown how students in collaborative reasoning discussions tend to copy one another's argument strategies. In this sense, the empirical education research showed how discussants tend to learn by discussing with a partner using particular argumentative behavior. Expert–peer interactions have been modeled in order to improve students' construction of arguments (Erduran 2007; Osborne et al. 2004) and encourage students' reflection about their positions (Jiménez-Aleixandre 2007) and reasons (Zohar and Ben David

2008), developing meta-cognitive skills through encouraging them to reflect on their own reasoning and arguments (Zohar 2012).

The teacher's guidance used to improve students' argumentative abilities can be analyzed and developed relying on the dialectical and linguistic studies. From a theoretical perspective, an argumentative move leads the interlocutor to adapting contingently to the speaker's argumentative behavior. The performance of a dialectical move, such as questioning a viewpoint or attacking a premise, opens specific possibilities to the interlocutor while blocking others. He is led to carrying out specific dialectical moves to reasonably contribute to the dialogue game (Ducrot 1972; Macagno and Walton 2014; van Laar 2014). In this sense, a student–expert dialogue can affect the student's dialectical behavior because the student's possible moves and countermoves are limited by the expert's dialectical choices. In this fashion, the expert can guide the student to perform more "critical" dialogical moves and enter deeper (in the sense of aimed at uncovering and solving the deeper cause of disagreements) types of dialogues. From an empirical point of view, previous studies showed that teacher-guided discussions were more efficient in "attaining higher levels of reasoning and higher quality explanations" (Hogan et al. 1999: 379; Kuhn and Crowell 2011).

In particular, we observed the quality of peers' argumentation with former interaction with an expert,[1] i.e. an arguer that uses more sophisticated (or rather deeper) argumentative (in this case dialectical) strategies. The purpose was to illustrate how discussions with experts can improve the interlocutors' argumentative behavior by enhancing a deeper understanding of the reasons underlying a position, and affecting the dialectical analysis of an issue. Our goal is to show qualitatively how and whether an expert–peer dialogue, by guiding the student to focus on the deep causes of the disagreement, can influence his dialogical behavior in further dialogues with a peer. This empirical study suggests to two distinct and interrelated questions, one empirical and one theoretical. From an empirical point of view, addressed quantitatively in Paus et al. (submitted), this study opens up the possibility of advancing a method for improving—at least in the short term—the students' argumentative behavior. From a theoretical point of view, tackled in this paper, the problem is to establish whether the expert, by adopting a more critical argumentative attitude (attacking the premises and revealing the grounds of the student's position), can induce the student to imitate the same dialectical strategies and focus

more on the deeper issues presupposed by the conflict of opinions.

3 A Coding System Detecting Argumentative Skill Development

The idea of "argumentative strategy," developed in Anderson et al. (2001) and Kim et al. (2007) for analyzing the snowball effect, tended to merge two levels that are theoretically distinct, i.e. the structure and the content of an argumentative move. Under the label of "strategy" fall both types of argument, defined based on their content (such as from consequences), and kinds of dialectical moves, such as questioning or rebutting. From a theoretical perspective, these two levels need to be distinguished, as they affect differently the interlocutor's behavior. As mentioned above, dialectical moves, intended as speech acts aimed at achieving a specific reply for the purpose of supporting or weakening a point of view, influence directly the interlocutor's behavior by limiting the paradigm of his possible replies. On the contrary, from a theoretical point of view this effect is not brought about on the content level. The refutation of a move or the questioning thereof can be performed by resorting to various kinds of arguments or types of reasoning, which are not determined by the speaker's argumentative choices. For this purpose, we used two distinct types of coding schemes. The first scheme is focused on the types of *dialectical moves* (functional level), while the second one takes into account the *types of argument* used (content level), in order to bring to light the nature of the positions and background knowledge that is debated.

3.1 Developing a Coding Scheme—Empirical Study

The development of the two distinct schemes was based on a sample of 16, 11 to 13-year-old, 6th to 8th-grade students (approximately half female) attending a public middle school in New York City. They were all participants in an ongoing twice-weekly curriculum in argumentation that the school had adopted as part of its regular curriculum. It focused around electronically conducted peer dialogs between a pair of students who held one position on a social issue and a succession of pairs of their peers who held the opposite position. Participants came from the same population as that described in earlier publications regarding this curriculum (Kuhn and Crowell 2011; Crowell and Kuhn 2014; Kuhn et al. 2013). The school is an academically challenging urban public middle school in an ethnically diverse low-to-middle-income neighborhood. Eighty percent were Hispanic or African-American, and 60 % qualified for free or reduced-price lunch.

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[1] In the empirical study conducted, the experts were Ph.D. students with no specific training in argumentation theory, who were instructed to use specific argumentative moves.

For the purpose of this study, three out of six students' electronic dialogs on a single topic were chosen for investigation. In the second of these three dialogs, an adult expert (i.e. an arguer instructed to use specific argumentative moves) was substituted for an opposing peer pair, unbeknownst to the participants. Based on these dialogs we will now illustrate how the interaction with an expert can influence students' argumentative behavior on a functional and a content level.

3.2 Coding Scheme—Functional Level

On the level of the structure of the dialectical moves, our analysis was focused on student pairs' use of strategies to attack the interlocutor. Strategies of attack are based on three distinct ways of refuting a viewpoint: (1) supporting an alternative and incompatible viewpoint (Counter A); (2) rejecting directly the interlocutor's viewpoint, showing its falsity or unacceptability (Counter C) (Felton and Kuhn 2001); (3) attacking by questioning or rejecting one of the premises on which the interlocutor's argument is based (Underminer). On this perspective, Counters A and Counters C represent a counterargument and a defeater (Pollock 1974, 1987), while underminers include the so-called undercutters, i.e. the attacks against the inferential link between premises and conclusion, and the questioning or rejecting of the premises that support the conclusion by supporting their falsity or asking critical questions (Walton 2006; Walton et al. 2008; Nussbaum and Edwards 2011). This distinction allows one to identify the dialogical moves that uncover the interlocutors' background beliefs. Underminers, by focusing on the reasons underlying a conclusion, can reveal deeper assumptions that are the basis of an argument, such as values, commitments, or criteria of classification. To code the dialogs, only content-related contributions serving to discuss the topic (such as "if they continue to misbehave, they should be expelled", "they could be homeschooled by a tutor") were taken into account. The segmentation was based on so-called dialog units. Note, that a dialog unit was not necessarily similar to a complete message, because in online dialogs a message is likely to include contributions of various length, structure and content. Consequently, a dialog unit can be a complete message, but can also be only one subpart of it (Jucks and Paus 2013; Asterhan and Schwarz 2009). Interrater agreement for roughly 50 % of the dialogs was very good with Cohen's Kappa $\kappa = .91$ (Krippendorf 2004). See Table 1 for the functional coding scheme.

3.3 Coding Scheme—Content Level

From the point of view of the types of argument used, the analysis has been based on the theory of argumentation schemes developed in Walton, Reed and Macagno (2008), in which the stereotypical patterns of argument are formalized. Argumentation schemes represent the combination of the material (semantic) link between premises and conclusion (such as cause-effect, authority, or consequences) and the type of reasoning used (such as *modus ponens*, abduction, or induction). In particular, six types of argumentation schemes have been chosen as the most adequate for the kind of task (supporting a decision) and topic (an ethical issue, expelling disturbing students from school) (Macagno and Walton forthcoming). The schemes were the argument from consequences and the argument from practical reasoning (schemes used for supporting a decision), the argument from values and the argument from rules (justifying an ethical or normative viewpoint), the argument from best explanation (tracing back a behavior or event to the most reasonable cause), and the argument from classification (supporting the categorization of a behavior, event, or state of affairs in a certain fashion). Other argumentation schemes that have been used, in particular analogy and example, have been placed under the category of classification, since they have been used only for classifying a specific behavior. Here, again the data coding was solely based on the content-related dialog units. As for the functional scheme, agreement between raters for roughly 50 % of the dialogs was good with Cohen's Kappa $\kappa = .87$ (Krippendorf 2004). See Table 2 for the content coding scheme.

Critical questions have been codified according to the schemes that they are undermining, as they belong to the same argument structure. For instance we consider the following argument attacked by using critical questions (Table 3).

The theoretical distinction between more and less sophisticated argumentative strategies and the design of the two interrelated coding schemes can be used to develop specific interventions aimed at improving students' argumentative behavior. In the section below, the qualitative results of the empirical study mentioned above will be presented, in order to provide the first hints for possible classroom activities.

4 First Insights into Students' Argumentative Behavior

The two coding schemes are aimed at detecting and analyzing the function of the dialogue units used to attack the interlocutor's move, and the argumentative content of the students' move. The purpose was to provide a method for detecting more sophisticated dialectical behavior, and describing how the dialectical moves are related with arguments. In this section we will illustrate how the coding schemes introduced might help us to better understand

Table 1 Categories of the functional coding scheme

Category (code)	Description of the category	Example
Strategies of attack		
Counter C	Rebutting the interlocutor's point of view by attacking the conclusion of his argument, showing that it cannot be accepted. For instance, the speaker can point out the bad consequences of a decision.	STUDENT 1. If they go to a new school, they can start all over!
		STUDENT 2. But going to a new school involves going to a new town and spending money because of it because their parents have to move and that involves getting a new house.
		(Dialog EX8-ST8)
		STUDENT 1. The kids should have punishment like detention or suspension before expulsion because they probably don't take the warnings seriously.
		EXPERT. But the school has told the parents and the students that the next step is expulsion, so there is no surprise.
		(Dialog ST6-X3)
Counter A	Attacking a position advancing an alternative and incompatible point of view. For instance, the speaker can point out another possible decision leading to better consequences.	STUDENT 1. Expulsion is too severe as a consequence.
		STUDENT 2. No it's not. It will be a better decision to expel them because then they will stop the whole class from moving forward.
		(Dialog EX5 ST5)
		STUDENT 1. Doris and Roger should be expelled because they received too many warnings and even though they received the warnings, they still misbehaved.
		EXPERT. They could suspend them, or ask them to do community service.
		(Dialog EX3-X1)
Underminer	Attacking the interlocutor's argument by countering one of the premises on which it is based. Instead of focusing on the quality of the conclusion, the underminer shows that the conclusion does not follow from the premises, or that one of the premises is not acceptable. For instance, the speaker can attack a classification showing that the evidence on which it is based is not correct. Or he can attack a sign showing that there can be an alternative explanation.	STUDENT 1. They can be homeschooled if either their parents have the time or they can get a homeschool teacher.
		STUDENT 2. But they won't listen to a tutor.
		STUDENT 1. If they are not listen to anybody in or out the school what's the point of having them learn.
		(Dialog EX4 ST2)
		EXPERT. But think of the consequences to the student if they are expelled and have to move or be homeschooled– the student may not be able to recover. Should we give up on the students?
		STUDENT 1. They have already been given many warnings. Their behavior has not improved. They are giving up on us we are not giving up on them.
		EXPERT. But they may not be giving up on school, maybe they can't help themselves like they have problems at home or emotional problems.
		(Dialog EX2-X1)
	Underminers can be also critical questions serving this purpose.	STUDENT 1. How is he going to learn if he is in detention all day?
		STUDENT 2. He'll go after school.
		STUDENT 1. What if he can't?
		(Dialog EX2 ST4)
		STUDENT 1. But they should still get expelled because they took the warnings as a game!
		EXPERT. How do you know they took the warning as a game?
		STUDENT 1. I know because if they listened the warnings they would of stop doing bad things.
		(Dialog EX1-X1)

Table 1 continued

Category (code)	Description of the category	Example
Other	This category includes all the other dialogue units that have been codified as "on task". The following categories of units have been included in this class:	
	Clarify: Explanation of one's viewpoint or position.	STUDENT 1. Roger and doris should be expelled because causing trouble and it might be hard for other kids to learn.
		(Dialog EX7-ST7)
	Clarify?: Request of clarification of a position.	STUDENT 1. But they have just gotten warnings, so they don't take.
		STUDENT 2. What do mean?
		(Dialog EX6-ST6)
	Interpret: Rephrasing of the interlocutor's move.	STUDENT 1. Maybe they have ADHD or some real problem that makes them behave that way…
		EXPERT. So you are saying that they have a problem that makes them interrupt.
		(Dialog EX6-ST6)
	Justify?: Request of a reason in support of a viewpoint.	STUDENT 1. They shouldn't be expelled because expelling them is to severe.
		STUDENT 2. Why can't they be expelled?
		(Dialog EX6-ST5)
	Coopt: Using the interlocutor's move to support one's own position.	STUDENT 1. But it would be better if they got a real punishment?
		STUDENT 2. What are you talking about a real punishment, because this is a real punishment.
		(Dialog EX6-ST6)

students' improvement in argumentative behavior after being exposed to an interaction with an expert. The goal is to provide a qualitative analysis of the prototypical dialogues before, during, and after an expert interaction, to examine the changes in dialectical behavior from a functional and content perspective.

From a quantitative point of view (discussed in detail in Paus et al. submitted), a noticeable change can be noted in the types of attack to the interlocutor's point of view before and after the expert interaction. The students tended to take into better account the interlocutor's position by attacking it, either by countering it directly (from 37 % to 47 %) or undermining it (from 16 to 22 %). On the contrary, they opted much less for the mere opposition of an alternative point of view (counter-alternative) (from 17 to 5 %). This type of behavior was mirrored from a content perspective by the types of argument used by the students. The practical reasoning, an argument preferentially used to provide an alternative solution to a problem, decreased (from 23 to 19 %), while the use of values (which are mostly used in solving deep disagreements, see Macagno and Walton 2014) increased (from 17 to 25 %). For the other categories of argument the difference was <3 %. The changes in behavior that these figures hint at will be illustrated

qualitatively by analyzing the dialogues that are most representative for the type of interaction.

4.1 Prototypical Peer–Peer Pair Dialogue (PP1)

The following peer–peer pair dialogue shows both the structure of the moves and the types of arguments that have been noticed to be most frequently used between students (Table 4). The students choose to attack the conclusion of the interlocutor directly, either by drawing the negative and potentially unacceptable consequences (moves no. 4, 6, 8, 12) or proposing an incompatible alternative (moves no. 2, 3, 5, 7, 11). Only in one case (move no. 13) the first student (ex2) undermines the interlocutor's argument by rejecting a premise upon which the whole argument rested.

4.2 Prototypical Peer–Expert Pair Dialogue (PEX)

The type of dialogical behavior is different in peer–expert interactions (Table 5). The expert questions the principles (the values) at the basis of the student's viewpoint (based on rules), pointing out that there are other possible causes of Doris' and Roger's misbehavior,

Table 2 Categories of the Content Coding Scheme

Category (code)	Description of the category	Example
Argument from consequences	A decision is supported by showing its good or bad consequences. MAJOR PREMISE: If A is brought about, then good (bad) consequences will occur. CONCLUSION: Therefore A should (should not) be brought about.	If they do community service they will not learn anything and most likely they will do the same thing. (Dialog EX2-X1)
Practical reasoning	The possible ways to bring about a state of affairs are compared and the best means is selected. PREMISE 1: My goal is to bring about A. PREMISE 2: I reasonably consider on the given information that bringing about at least one of $[B_0, B_1, …, B_n]$ *is* necessary to bring about A. PREMISE 2: I have selected one member B_i as an acceptable, or as the most acceptable necessary condition for A. CONCLUSION: Therefore, I should bring about B_i.	The consequences could be less extreme if we opt for solutions like suspension or community service. (Dialog EX2-X1)
Argument from values	An action is chosen because it is classified as good or bad based on a positive or negative value. PREMISE 1: Value V is *positive* as judged by agent A (judgment value). PREMISE 2: The fact that value V is *positive* affects the interpretation and therefore the evaluation of goal G of agent A (If value V is *good*, it supports commitment to goal G). CONCLUSION: V is a reason for retaining commitment to goal G.	We think Doris and Roger should be expelled because they are disrupting the class and it is not fair to any of the other students. (Dialog EX2-X1) We think Doris and Roger should stay in school because education is a right. (Dialog ST1-X2)
Argument from best explanation	The most reasonable cause of an event or a state of affairs is found by comparing alternative possible explanations. PREMISE 1: F is a finding or given set of facts. PREMISE 2: E is a satisfactory explanation of F. PREMISE 3: No alternative explanation E' given so far is as satisfactory as E. CONCLUSION: Therefore, E is plausible, as a hypothesis.	They are the "bad" kids they are the "bullies" they don't want a rumor starting that they are all soppy and soft they are probably truly suffering from a mental disease that is making them fell depressed. (Dialog EX5-ST8)
Argument from rules	A decision is made based on a rule that applies to a specific case. MAJOR PREMISE: If carrying out types of actions including the state of affairs A is the established rule for x, then (unless the case is an exception), x must carry out A. MINOR PREMISE: Carrying out types of actions including state of affairs A is the established rule for a CONCLUSION: Therefore a must carry out A.	They had many warnings; therefore, they deserve to be expelled. (Dialog EX3-ST1) They can't jump from warnings to expulsion because they haven't had any consequences! (Dialog EX7-ST6)
Argument from classification	A state of affairs is classified in a certain fashion based on a definitional or classificatory criterion. MAJOR PREMISE: If some particular thing a can be classified as falling under verbal category C, then a has property F (in virtue of such a classification). MINOR PREMISE: a can be classified as falling under verbal category C. CONCLUSION: a has property F.	Education is about learning how to work effectively with your peers, and sometimes those peers are distracting and have behavioral problems. So in some ways, Doris and Roger are contributing in meaningful ways to the school. (Dialog EX5-X1) How do we know what types of warnings they got? Because it could have been small warnings, and small warnings do not justify expulsion. (Dialog ST1-X2)

which can result in other more reasonable and useful ways to solve their problems (moves 4, 6). The student is brought to reflect upon the interpretation of the kids' disruptive behavior, and on the responsibility of schools in addressing their problems (moves 5, 7). The expert, in this fashion, shifts the dialogue to an analysis of the way that the school has handled the kids' behavior and the values (the social values in this case) at the basis of the choice of expelling Doris and Roger (moves 8, 10, 12).

This interaction shows how the argumentative strategy of the expert is focused on unveiling the reasons at the basis of the student's position, i.e. the interpretation of the state of affairs under discussion (the reasons of the kids' behavior) and the values underlying the expulsion. By undermining the interlocutor's arguments, the expert addresses the roots of the disagreement.

4.3 Prototypical Second Peer–Peer Pair Dialogue (PP2)

The peer–peer interaction that followed the dialogue with the expert shows a strategy that is different from the one pursued in the first peer–peer interaction (Table 6). The students do not attack the conclusions of the interlocutors' reasoning directly, drawing consequences or proposing alternatives. Instead, they challenge the principles underlying the viewpoints, pointing out internal contradictions. This dialogue is based on the values underlying the positions (expelling the students or punishing them in other ways) (moves 2, 7, 11, 12, 13) and the interlocutors' deep commitments about them. This latter issue in particular is discussed in a dialogue of a different level, focused on the grounds of a position (14–22).

Table 3 Critical questions to attack arguments

Argument from consequences	There are other kids in the class that want to learn. The disruptions are affecting their education. (Dialog ST1-X2)
Questioning the factual grounds	How do you know there are more kids in the class besides them? (Dialog ST1-X2)
Argument from rules	They disrupted the other kids in the class. Therefore they should be expelled. (Dialog ST1-X2)
Questioning the application of the rule to the specific case	How do you know what they did to deserve to get expelled? (Dialog ST1-X2)

Table 4 Example of an expert–peer dialog

Turn	Communication partner	Contribution	Code
1	ex2	We are for expulsion because they have been warned and so they did not take the warning so. they deserve to be expelled!?	O/AR
2	St2	They have a right to be educated.	CC/AV
3	ex2	They can be educated just not at that school.	CA/PR
4	St2	It is the only school in town.	CC/PR
5	ex2	They can go to another town.	CA/PR
6	St2	So they have to move.	CC/AC
7	ex2	They don't have to. They can get a tutor.	CA/PR
8	St2	Tutors specialize in one subject.	CC/AC
9	ex2	No. not always, sometimes tutors teach the kids all of these subjects. [Moreover] they are in the same town and could relate to each other.	CC/AC CA/PR
10	St2	Could you explain that a little more didn't quite catch ya.	O/O
11	ex2	Nick and Doris and Roger both live in the same town they could meet each other and science nicks parents are homeschooling him they could probably arrange for them to home school Doris and Roger.	O/PR
12	St2	We said tutors cost a lot. That ruins Nick's education of undivided attention.	CC/AC
13	ex2	He is growing up he does not need undivided attention.	U/AC
14	St2	This was settled that Nick education is mixed out when there is undivided attention. Doris and Roger will ruin that attention to Nick.	CC/AC CC/AC
15	ex2	Doris and Roger just need some time. They will not keep doing it. It is just a habit.	CC/PR O/BEX

O Other, *CC* Counter C, *CA* Counter A, *U* Underminer, *AC* argument from consequences, *PR* practical reasoning, *AV* argument from values, *AD* argument from classification and definition, *AR* argument from rules, *BEX* argument from best explanation

Table 5 Example of a peer–expert dialog

Turn	Dialog partner	Contribution	Code
1	EX1	Doris and Roger should be expelled because they received too many warnings and even though they received the warnings, they still misbehaved.	O/AR
2	Expert	But its very extreme to go to expulsion– they could suspend them, or ask them to do community service.	CA/ AC + PR
3	Ex1	But they should still get expelled because they took the warnings as a game!	CC/BEX
4	Expert	How do you know they took the warning as a game?	U
5	ex1	I know because if they listened the warnings they would of stop doing bad things.	U/BEX
6	Expert	Maybe, but what if they aren't playing games, they just can't help themselves, like they have problems at home or emotional problems.	U/BEX
7	ex1	Then isn't there a way to settle their problems or concerns?	O/PR
8	Expert	I don't know—but if all the school is doing is giving them warnings then they haven't tried.	U/BEX
9	ex1	what if they had tried, but they thought that misbehaving was the better path to take?	U/BEX
10	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".	U/AV
11	ex1	what if the school tried, but they weren't successful?	U/BEX
12	Expert	then they should try again! You shouldn't give up on kids—these are public schools, to give up on a public school student should be against the law.	U/ PR + AV

Table 6 Example of a peer–peer dialog after expert interaction

Turn	Communication partner	Contribution	Code
1	ex2	He should be expelled because he has already gotten warnings.	O/AR
2	ST4	But still expulsion is too severe for just fooling around.	U/AV
3	ex2	Well if they fool around the rest of the class will fool around. Thanks.	U/AC
4	st4	Then they should get detentions.	CA/PR
5	ex2	But, they already have gotten a next to expulsion thing.	CC/AD
6	st4	The article doesn't say that.	U/AD
7	ex2	How is he going to learn if he is in detention all day.	U/AC
8	st4	He'll go after school.	U/PR
9	ex2	What if he can't.	U/PR
10	st4	He'll be forced too.	U/PR
11	ex2	But!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! that is not fair.	U/AV
12	st4	I know but school is crazy like that.	O/AV
13	ex2	That does not make sense.	O/AV
14	st4	Well, you don't want to be at school right now, but you're forced!!!	U/AV
15	ex2	School is about learning and I like learning.	U/AV
16	st4	So you like school?	O/AV
17	ex2	Yes kinda.	O/AV
18	st4	Even hw and getting yelled at?	O/AV
19	ex2	Na not that part.	O/AV
20	st4	But anyway you're forced to do that though!!!!	O/AV
21	ex2	This is way of topic.	O/O
22	st4	I'm just saying you are forced to do things you don't want to do, like go to detention.	O/AV

This latter dialogue shows the dialogical difference made by the use of underminers. Underminers can shift the dialogue to a deeper level, leading the interlocutor to addressing the reasons of a specific viewpoint. Such dialogues could be crucial for solving deep disagreements or misunderstandings.

5 Underminers, Meta-dialogues, and Background Knowledge

As noticed in the dialogues above, underminers can be used to open a dialogue of a different level, called "meta-dialogue" (Krabbe 2003; Walton 2007). Meta-dialogues are aimed at discussing not the acceptability of a viewpoint, but rather the conditions of a dialogue or, in the specific cases analyzed, the conditions of an argument. Meta-dialogues can be focused on how a premise can support a conclusion, i.e. the material link and the respect under which a premise is relevant for the conclusion (Govier 1985; Macagno 2008; Macagno and Zavatta 2014). The speaker for instance can attack the relationship between a characteristic of the state of affairs advanced as a reason and the material relation linking it to the conclusion. This attack can open a dialogue on the acceptability of a specific dimension the argument itself. In this sense, meta-dialogues and in many cases underminers can play a crucial role in the development of metastrategic knowledge, i.e. the awareness of the thinking strategies that are used (Zohar and Ben David 2008: 60; Zohar 2012: 199). The students, by assessing, attacking, and discussing the acceptability of an argument or the premises thereof, can acquire awareness of the thinking mechanisms and

argumentative reasonableness. For instance, we consider the following excerpt (Table 7), in which the meta-dialogue becomes a dialectical instrument for assessing the reasonableness of the classification of a state of affairs and the application of a rule:

In this dialogue, the first student (ex3) supports his conclusion based on the principle of inference drawn from the rules of the school (after a certain number of warnings, a student shall be expelled). The second student (ST1) attacks the relationship between the premise and the principle of inference, pointing out that the conclusion can be drawn only depending on the type of warnings. This attack (questioning) opens a meta-dialogue on the relationship between the premise and the conclusion of the argument. The first student defends the principle of inference on which he grounded his argument (the *quantity* of warnings results in expulsion), which is then rejected by a different rule (the *quality* of the warnings determines the punishment), which ultimately leads to the undermining of the whole argument (if the type of warnings has not been specified, you cannot punish the students in the most severe way).

In the following case, the meta-dialogue is focused on an argument from values (Table 8). The student (ex7) claims that the two students Doris and Roger should be expelled based on the rule that after a certain number of

Table 7 Meta-dialogue 1

Turn	Communication partner	Contribution	Code
2	ex3	[They should be expelled] because he had too many warnings.	O/AV
3	ST1	But what warnings did they have?	U/AD
4	ex3	They had a lot and it doesn't matter what warnings they have.	U/AD
5	st1	Well, according to what warnings they got [you] determine what punishments they should get.	U/AR
6	ex3	But it didn't say what warnings they had.	U/AD
7	st1	So then why should they get such a bad punishment?	U/AR

Table 8 Meta-dialogue 2

Turn	Communication partner	Contribution	Code
8	x1	Right, detentions and suspensions are not enough; they are like temporary "band-aids" to fix the problem for a little while. This is why the teachers and faculty must make an effort to fix the root of the problem by meeting with the student and their parents to figure out the real root of the problem.	O/AC CA/PR
9	ex7	But no one is helping them be a better person.	U/PR
10	x1	Well, shouldn't this become a primary goal of the teachers and faculty?	U/AV
11	ex7	It isn't, since they aren't helping, the principle isn't helping either.	U/BEX
12	x1	Right, teachers and the principal are clearly not doing enough to help Doris and Roger be the best they can be. All they do is issue warnings. This is the best way to ensure Doris and Roger's success—not to just dump them by expelling them. It's the lazy way out.	U/O O/O CA/PR
13	ex7	It's not crazy, it's the way Doris and Roger want it, since they aren't stopping.	U/BEX

warnings they should get a serious punishment. The expert attacks the argument and proposes alternative ways to solve the problem (meeting with the parents to understand and fix the root of the students' problem). At move no. 9, the student insists in focusing on the bad behavior (they are not good persons) and the expert starts a meta-dialogue on the ethical principles at the basis of the rules of the school (move 10).

The meta-dialogue directs the student to take into account the ethical principles behind expulsion and punishment. As a consequence, he accepts the value advanced by the expert but attacks the applicability thereof to the specific case, as the students do not want to be helped (move 11 and 13).

Meta-dialogues can be focused on different types of argument, such as classifications (meta-dialogue 1) or values (meta-dialogue 2). In (Table 8), at move 7, ex7 opens up a meta-dialogue on the reasonableness of the interlocutor's practical reasoning, which leads to a dialogue on the values underlying a decision (moves 10–11) and the interpretation of the state of affairs on which they are discussing about (moves 12–13).

6 Discussion

6.1 Conclusion

This paper addresses from a qualitative point of view two interrelated issues: how to detect, describe, and assess the argumentative behavior of students in classroom discussions, and how to intervene in order to improve their argumentative abilities. In this sense, we tried to provide a method for evaluating dialogical moves according to argumentative criteria, in order to distinguish the more sophisticated and effective strategies from the others. This theoretical proposal has been used in a practical fashion, to propose a possible classroom intervention.

The first question was tackled by introducing a twofold coding scheme aimed at capturing the argumentative behavior of students' interactions from both a functional and content perspective. The interrelated use of the two coding schemes shows how it is possible to merge the more functional approaches (developed mostly by Kuhn and her collaborators) with the more structural and argument-oriented perspectives based on the Toulmin Argument Model. How shown by the qualitative analyses of students' dialogues, the functional and the content schemes can code and bring to light different types of argumentative moves and describe them according to their role in addressing the other's perspective and influence the process of belief change. In particular, this paper underscored how specific dialectical moves can be used to address and discuss background knowledge, i.e. the deeper grounds of a specific viewpoint. In this fashion, argumentative behavior can be examined and assessed according to its dialogical function, i.e. to address the other's point of view and guide the interlocutor to a change of perspective. The deeper and more sophisticated argumentative moves can be detected through the functional scheme, while the content scheme discloses the dimension of the viewpoint that is discussed or attacked in the dialogue. From a qualitative perspective, we have shown how the two levels of analysis can be used in combination to bring to light the nature of the dialogues on deep disagreements, which we called meta-dialogues. This account shows how the same types of argument can be used at different levels with distinct effects. For instance, arguments from values can be used to attack a position by opposing to it a different value; however, only when an argument is undermined and the hierarchies of values are discussed it is possible to address the root of a disagreement.

These theoretical insights shed light also on the second issue, concerning the possible interventions aimed at improving students' argumentative skills. This study provides first hints at possible activities that can be used to influence students' dialogical behavior. We have shown from a qualitative point of view how interactions with an expert—who uses specific and more sophisticated types of attack—can affect the students' argumentative behavior also in later dialogues. In this sense, this study points out the possibility of transferring the skills of argumentation, and in particular the strategies focused on addressing deeper misunderstandings or disagreements, through practice, and not simply teaching (see Zohar and Nemet 2002).

6.2 Limitations and Implications for Further Research

The results of this study provide a promising approach to foster argumentative skill development in the classroom. Curricula (see Kuhn et al. 2014) based on the approach of argumentation as a dialogic process (as distinct from argument as a product, see Kuhn and Udell 2007) suggested integrating short interactions with a more sophisticated interlocutor. Experiencing a real (skilled) interlocutor—instead of being taught argumentative strategies by instruction—enables them to internalize the dialogic frame and helps them understand the purpose of argumentation and argumentative writing. In this vein, such "natural" learning approaches could be of high interest for developing methods for tutoring or designing remedial lessons regarding motivational aspects with students becoming an active part of the teaching process (Ames 1992).

The practical outcomes of this study are grounded on specific concepts that can be generalized. In particular, this work has taken into account a particular type of expert (or rather an interlocutor using more sophisticated

argumentative strategies), a particular type of population, and particular types of topics that have been treated in argumentative dialogues. These three defining characteristics of the study, however, can be encompassed by more general considerations that can apply to a much broader idea of expert, to a much wider population, and to different types of subject matters.

Concerning the first limitation, we noticed in the paper that the students' argumentative behavior was influenced by the interlocutor's moves. In this specific case, the experts were Ph.D. students, i.e. adults with a specific training in education. However, these results suggest that it is possible to generalize the idea of improving students' argumentative skills through interactions with a generic expert. Teachers or tutors can focus their argumentative dialogues on questioning the premises of a position, i.e. asking the critical questions that could undermine an argument (Walton et al. 2008), until attacking the classifications and the definitions at the basis thereof. Our argument structure analysis provides a guideline for addressing specific types of attacks (the critical questions) related to the kind of arguments used by the interlocutor. By identifying the type of argument, arguers can retrieve the specific type of underminers that can be used to attack the interlocutor's reasoning (Walton 2005).

The findings presented here are limited to the population of middle school students whose argumentative skills are rather weak and who might preferentially benefit from a discussion with a partner that uses deeper or more sophisticated argumentative strategies. However, the specific dialectical strategies analyzed in this paper can also be used to make arguers aware of the types of moves that they are performing and the effects that they can elicit. Future research should look at other populations (such as university students) to find out whether and how such an intervention also works for more skilled arguers.

Concerning the last limitation, this study was conducted by taking into account ethical issues (punishments in schools, war intervention) in order to point out the dialectical dimension of the discussions. However, the outcomes of this study provide insights that can be applied to other educational contexts. Distinct strategies of refutations, and in particular underminers (Damer 2001), can be used to induce the students to evaluate the previous scientific conceptions on which their arguments were based. For instance, undercutting arguments by attacking the definitions of crucial concepts (such as the idea of "temperature" in discussions about thermodynamics) can be an effective instrument for guiding students to restructure their view on and their understanding of a specific issue (Konstantinidou and Macagno 2013; Nussbaum and Sinatra 2003; Cross et al. 2008).

The last global consideration concerns the duration of the effects of the argumentative strategies analyzed in this study. This work is based on a short intervention, which, however, was shown to already elicit changes in the argumentative behavior of middle school students. This effect raises the question of whether such effects would remain over a longer time period. Will students still take advantage of such an intervention after a couple of weeks or even a year? Would their argumentative behavior improve even more, if they participated in expert-dialogs on a regular basis? A possible direction of future works could be the investigation of the possible effects of this kind of argumentative interventions, i.e. the long-term effects on argumentative skills (increased awareness of argumentative strategies), and the short-term learning effects (conceptual change) in different educational domains.

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