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A close look at children's and adolescents' arguments: combining a developmental, educational, and philosophical perspective

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Abstract
It is broadly admitted that social contexts of reasoning may prompt children and adolescents to improve the quality of their reasoning. However, it is not clear how this quality may be assessed when it comes to arguments expressed within oral interactions in diverse settings (whole-class or small-group discussions) by students of different ages and cultural backgrounds. This study aims to offer a methodological contribution to the issue of oral argument assessment of children and adolescents, by looking at a large, annotated corpus of dialogic discussions during 111 lessons taking place in five countries. Our analysis combines a structural (Toulmin Argument Pattern) and functional (Walton's argumentation schemes) approach to argumentative reasoning. Our findings show significant variations across age groups and social settings. The discussion points out the importance of sociocultural framing of argument reasoning development and the continuation of research in argument assessment methods able to grasp important developmental and cultural variations.

Keywords Argument assessment · Age · Culture · Sociocultural framing · Structural and functional analysis

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Introduction

It is well reported in the literature that children are able to argue and counterargue from a very young age. This naturally developed skill does not imply mastery, but neither excludes the possibility of improvement through explicit teaching or immersion in argumentation (e.g. Dawson & Venville, 2010; Kuhn et al., 2016; Reznitskaya et al., 2007). However, even in those cases where youth's argumentation is prompted, the quality of individual arguments is not always high, mostly due to the presence of biases (e.g. confirmation and 'my-side' bias, see Felton et al., 2015), lack of motivation (willingness to justify, see Klaczynski, 2000), or lack of positioning (explicit expression of a perspective, see Hsin & Snow, 2017). It is also broadly admitted that social contexts of reasoning may prompt children and adolescents to improve the quality of their individual reasoning (Garcia-Mila & Andersen, 2007; Iordanou et al., 2016; Kuhn, 2018; Muller Mirza et al., 2009). However, it is not clear how such quality differs across different ages, especially when participants are supported with similar tools and activities. A closer look at the specific argument potentialities emerging at each age group is necessary for educators to adapt their teaching models and expectations (Auriac-Peyronnet, 2001; Carugati & Perret-Clermont, 2015).

The present study simultaneously adopts a developmental, educational, and philosophical perspective to look at children and adolescents' individual arguments in a context of classroom discussions about social issues. The questions we aim to address are:

1. From an educational perspective: When do arguments mostly emerge? During a whole-class or a small-group discussion?
2. From a philosophical perspective: What kinds of arguments do children and adolescents make? What is their structural quality (i.e. complexity and explicitness) and their nature (i.e. type of reasoning)?
3. From a developmental perspective: What are some identified developmental trends in socially emerging argumentation skills, as manifested in different age and cultural contexts?

Literature review

The development of argument skills in childhood and adolescence

The argumentative competency, understood as the comprehensive set of argument skills such as constructing arguments, counterarguments, and rebuttals (Rapanta, 2019; Kuhn, 1991), grows between as early as 3 or 4 years and 17 years (Golder & Coirier, 1996). There is vast evidence that children from a very young age are able to recognize conflicting views, willingly engage in an argument to defend their position, and adhere to personal goals as their main motivation to maintain an argument (Dunn & Munn, 1987; Kuczynski et al., 2018; Stein & Bernas, 1999). However, the early emergence of young children argument skills usually occurs within contexts that are highly familiar and personally meaningful for children, as for example family negotiations (e.g. Arcidiacono et al., 2022; Stein & Albro, 2001). Very few studies with pre-schoolers, commented in the next section, take place within a formal context, such as kindergarten or preprimary

school. Moreover, all the above studies adopt a pragmatic rather than a knowledge-oriented approach to argumentation (Carugati & Perret-Clermont, 2015).

Regarding the quality of children's arguments, studies show that preschool age children are able to give reasons to support their side of an issue (Dunn & Munn, 1987; Köymen & Tomasello, 2018), and also to attack their opponent's side (Stein & Miller, 1991). By age 3, children are able to 'generate and think about positive and negative reasons for pursuing different courses of action or for holding specific sets of beliefs' (Stein & Bernas, 1999, p. 97). A study by Scholnick & Wing (1991) showed that children from the age of 4 are able to use all types of conditional (*if*-type) inferences, such as modus ponents, modus tollens, refutations, and biconditionals. However, most of the children's inferences are not spontaneous but elicited by adults. Orsolini & Pontecorvo (1992) showed that 5-year-olds can produce justifications, linking between an event and a condition, followed or not by *because*; however, the temporal meaning of *because* is not yet acquired by that age. Similarly, the identification and production of valid and relevant counterarguments only occurs as early as 5 years old, probably because younger pre-schoolers find it difficult to understand others' beliefs and reasons for these beliefs (Mammen et al., 2019). Overall, as Mercier (2016) remarks, the early emergent argument skills among children 'does not mean that there is not ample room for development and improvement' (p. 692).

As children move from pre-school to primary school, they are not only able to generate longer arguments (Stein & Albro, 2001; Stein & Bernas, 1999), but they also become more strategic in their use of argumentative discourse. For instance, Domberg et al. (2018) showed that 7-year-olds as compared to 5-year-olds produce not only more affirmations but also more refutations (i.e. while 5-year-olds were able to explain to their peer why a toy animal should go to their own side, 7-year-olds were able to explain to their peer why a toy animal should not go to their peer's side). Similarly, Clark & Delia (1976) showed that 8-year-olds significantly differ than 7-year-olds, and 9-year-olds differ from 8-year-olds in their ability to consider the other's perspective. However, children's knowledge about the positive aspects of another's position (what Kuhn calls 'support other'; see Kuhn et al., 2016) or about problems with their own position ('weaken own', ibid) does not seem to increase with age (Stein & Bernas, 1999). In fact, confirmation bias, i.e. utterances exclusively supporting one's own point of view ignoring other-supporting evidence, are found to be equally predominant among 9-year-olds (Pontecorvo & Girardet, 1993) and twelve-year-olds (Garcia-Mila et al., 2013).

The above findings confirm that 'even though argumentive skills may have an evolutionary basis, they do not emerge fully fledged' (Mercier, 2011, p. 182). Research suggests that as children grow older, they gradually develop a prototypical representation of argumentative discourse (or 'argument schema', Reznitskaya et al., 2001), which is not fully set until the age of 13 or 14 (Coirier & Golder, 1993). This is confirmed by studies comparing between adolescents and adults. Felton & Kuhn (2001), for instance, showed that adults produced a significantly higher frequency of advanced counter-argumentation strategies, such as 'cornering' and rebuttal. Felton (2004) showed that advances in adolescents' argumentative discourse are more evident, when practice is combined with reflection. These results in combination show that differences across age groups may be due to differences in argument goal understanding, which can be enhanced and promoted intentionally. However, there is lack of comparison across different age spans, in particular between primary school children and adolescents, to grasp the exact evolutionary passage from the narrative schema, predominant among primary school students, to the argument schema, emerging in early adolescence (Surrain et al., 2019).

The role of educational interventions

On the one hand, it is generally accepted that peer interactions foster the experience of 'socio-cognitive conflicts' (Carugati & Perret-Clermont, 2015) which induce more spontaneous, and often deeper, argumentation (Mammen et al., 2019). This view is rooted in Piaget (1965), who claimed that for a child's move from egocentrism to others' consideration, arguments with equal-status peers are of major importance. On the other hand, it is vastly shown that the role of the teacher as a mediator of (argument) knowledge construction has also a great impact on students' (better) manifestation of argumentative reasoning (e.g. Rapanta, 2021; Larrain et al., 2014; Reznitskaya & Wilkinson, 2021). This view is rooted in Vygotsky's (1978) socio-constructivist theory of learning, according to which significant others may play the role of mediating between the social and individual knowledge construction. Combining the two views, it can be expected that within educational contexts that favour the construction of arguments, following either a whole-class or a small-group design, children and adolescents' potential will be at its best.

Orsolini & Pontecorvo (1992), in their analysis of 5-year-old classroom discussions, found that the more elaborate students' oppositions are to a previous claim, the more possible it is for them to be followed by more justified counter-oppositions (rebuttals), which in turn are followed by further counter-oppositions. When it comes to teacher-student interactions, they found that contributions that are followed by teacher's repetition, legitimizing student ideas, are more likely to be expanded by subsequent speakers.

Using an experimental design setting, Mammen et al. (2019) showed that training in discourse allowing 3-year-olds to be exposed to valid and non-valid counterarguments enabled them to identify and produce more valid counterarguments after training. In addition, in a collaborative decision-making context, always within an experimental setting, 7-year-olds were able to engage in significant metatalk about the validity and quality of evidence used in their arguments (Köymen & Tomasello, 2018). Similarly, Kline (1998) found that children from various age groups, ranging from 8 to 12 years old, show higher argument skill when they report having experienced situations in which they were exposed to collaborative argumentation.

After training in a written argumentation task with 10-year- and 11-year-old participants, Auriac-Peyronnet (2001) found that the impersonal marker 'on' (in French) appeared in more and more texts for both age groups at the end of the intervention, showing the adoption of a greater distance from their texts. A contrary tendency was observed with the use of the marker 'I' which decreased for both groups, but marked a radical disappearance only for the 11-year-olds. The same significant decrease only for 11-year-old participants was also observed with the use of narrative utterances, confirming the sharp decrease of narrative tendency at the beginning of adolescence, and its replacement by a massive use of justification.

Overall, it can be claimed that participating in reasoned discourse facilitates the manifestation of more advanced argument strategies by both children (Köymen et al., 2020) and adolescents (Felton, 2004; Kuhn et al., 2016; Reznitskaya et al., 2001). However, the conditions under which this facilitation takes place are not yet fully uncovered. Several factors may be influential, such as topic/issue of discussion (e.g. Schwarz & Glassner, 2003; Schwarz & Linchevski, 2007), prompts made by others, either peers or adults (e.g. Dawson & Venville, 2010; Ge & Land, 2003), and students' ability and motivation (Klaczynski, 1997; Means & Voss, 1996). Other factors such as culture and age are not yet sufficiently studied within a formal education context.

Oral arguments' assessment

The identified problem this methodological study aims to address is the lack of comprehensive assessment tools able to grasp the qualitative differences in children and young adolescents' oral arguments, when it comes to different age, dialogue setting (whole-class or small-group), and cultural background. Below we list some highly cited works in the field of educational argumentation that propose concrete ways of assessing children and/or adolescents' oral arguments and we identify some weaknesses for each. After that, we make explicit the unique characteristics of our methodological proposal.

Erduran et al. (2004) TAP-ping model

Erduran et al. (2004) propose an adaptation of Toulmin's (1958) Argument Pattern (TAP) 'as a tool for tracing the quantity and quality of argumentation in science discourse' (p. 916). Their adaptation regards two different methodological tools: (a) a quantitative one, based on the combination of two, three, or four argument components in one argumentation unit; and (b) a qualitative one, based on the identification of five levels of argumentation according to the quality of reasoning and counter-reasoning. In both cases, the unit of analysis is a sequence of classroom interaction (argumentation episodes) either with the whole class or in small groups.

Although the TAP-ping five-level coding framework has been influential among educational researchers, we think it is quite restrictive when it comes to grasping individual differences related to the quality of arguments produced. First, data, warrants, and backing are considered belonging to the same level of reasoning. This is quite problematic and incongruent with Toulmin's (1958) initial conception and description of the model, for which backings are of a higher level of reasoning. A second problem has to do with the fact that the framework is able to grasp arguments as taking place during oral discourse among several participants, including teachers and students alike. It therefore focuses on the overall argument quality of classroom discourse, not on assessing individual contributions, which would allow for insights on how different students contribute differently to the argumentative discussion.

Felton and Kuhn (2001) scheme for coding argumentive dialogue

Felton & Kuhn (2001) proposed a well-known scheme of 25 coding categories, distributed between eight types of transactive questions (i.e. utterances that request a response from a partner), 15 types of transactive statements (i.e. utterances expressing a speaker's thoughts directly connecting to a partner's previous utterances), and two non-transactive statements (namely utterances having no apparent connection to the preceding utterances, or continuations of a speaker's own previous utterance ignoring the partner's preceding utterance). The scheme aimed to distinguish argumentative from non-argumentative discourse emerging within dyads' argumentative dialogues about a controversial issue. As such, it is not recommended for whole-class or even small-group interactions, as the focus is on how two disagreeing partners use discourse.

Pragmadialectics and argumentum model of topics

As part of the ArgImp ('Analyzing Children's Implicit Argumentation') project, an interdisciplinary research team (Perret-Clermont et al., 2019) aimed at unveiling the argumentive potential of young children's inferences, through applying a combination of the Pragmadialectical theory of argumentation (Van Eemeren & Grootendorst, 2004) and the Argumentum model of topics (Rigotti & Greco, 2019). This approach, although highly useful for unveiling hybrid argumentation forms produced by young children, requires a twofold reconstruction process from part of the researchers: first, they need to reconstruct the dialogue context in the form of a critical discussion following the steps described by the Pragmadialectics; second, they need to reconstruct both the material-contextual (*endoxa*) and the inferential-procedural (*loci*) components of each argument. As such, it may prove itself unpractical when dealing with a large corpus of data, produced 'in the wild' (meaning the natural classroom context, and not an experimental condition, such as an interview). Moreover, as the ArgImp researchers remark, their approach focuses on argumentation as a contribution to a discussion, and not on the individual skills or differences implied by the different ways of arguing (Perret-Clermont et al., 2019).

Walton's argumentation schemes

The theory of argumentation schemes (Walton, 1996; Walton et al., 2008) is rooted in the idea that all arguments are by nature dialogic—they, therefore, serve a communicative function that can be represented in a schematic premise-claim prototypical structure, with premises serving different goals such as practical reasoning, consequential thinking, and analogical reasoning. Complementing Toulmin's (1958) structural approach to argument assessment, Walton's argumentation schemes provide a functional perspective towards distinguishing a type of argument from another, and, thus, they have been largely used in educational research (for an overview, see Rapanta, 2022).

What we present in this paper is a methodological approach that (a) can be applied in both peer-to-peer and teacher-student interactions alike—in this way, the effect of educational design aspects when it comes to the dialogue setting of discussions can be observed; (b) can be applied to more or less complete arguments, as long as a core argument structure (a claim supported by some data—see also below) can be identified, without the need of reconstructing the missing argument elements; (c) places a focus on individual arguments produced as part of a dialogic process and not on arguments-as-processes, which is also essential but cannot be used as an indicator of individual differences (for the distinction between argument-as-product and argument-as-process see O'Keefe, 1982); (d) embraces both structural and functional characteristics of arguments; and (e) is applicable to large corpora allowing for the identification of general trends deserving further attention.

Our goal is to closely look at the types of arguments children and adolescents from three age spans (5–6, 8–9, and 14–15 years old) jointly produce as part of their whole-class and small-group interactions, given certain common conditions. Looking at arguments-as-products rather than arguments-as-processes allows us to identify individual differences in terms of age group and socio-cultural framing of interaction (dialogue and country setting), which can inform educational designs aiming at the promotion of argument skills.

Method

Context and participants

The study was part of a large European project aiming at developing cultural literacy skills across formal education through dialogic and argumentative discussions mediated by wordless texts and films. The focus of the classroom-based discussions (both whole-class and small-group) was on cultural literacy dispositions such as tolerance, empathy, and inclusion to develop students' intercultural citizenship (Rapanta et al., 2021b). A milestone of the project was the creation of the Cultural Literacy Learning Programme with ready-to-use lesson plans adequate for each age group (preprimary, primary, and secondary). All lesson plans included discussions about key social issues related to being an intercultural citizen (e.g. solidarity, social responsibility, inclusive societies), triggered by a previously selected cultural text (picture book or short animated film). As all eight lessons of the programme focused on the same wordless film or picture book, their structure was the same for all participant countries. Our data collection focuses on lessons 3 and 8 of the programme's implementation in five countries: UK, Portugal, Cyprus, Spain, and Germany. The detailed learning programme lesson plans are described in Rapanta et al. (2023). The student participants belonged to three different age groups and were distributed across the countries as shown in Table 1.

Students had different socio-economic backgrounds, representing therefore heterogeneity within and across the five partner countries. The average age of the preprimary group was 5 years old, of the primary group it was 8.5 years old, and of the secondary group it was 14 years old. Considering the gender distribution, participants represented a balanced sample between male and female students. Regarding the within-classroom ethnical diversity, the majority of the participant classes (81%) were classified as 'low or medium ethnical diversity' (proportion of other-ethnicity students lower than 5% or 15% per school, correspondingly), and 19% of high ethnical diversity (for a proportion higher than 15%). These data were not available for Portugal due to school regulations. In total, there were $N = 111$ lessons analysed, homogenously distributed between educational levels and countries as it can be seen on Table 2.

Corpus construction

The data collection consisted of audio and video recording of 111 lessons distributed across the five countries and three age groups (Table 2) including both whole-class and small-group discussions. Before the data collection, all researchers in the five countries guaranteed that all participant teachers and their students' parents/caregivers had correctly

Table 1 Number of students involved in the study

Age group	Country					
	UK	Portugal	Germany	Spain	Cyprus	Total
Pre-primary	720	181	22	100	520	1543
Primary	720	167	115	125	575	1702
Secondary	240	328	230	115	50	963
Total	1680	676	367	340	1145	4208

Table 2 Number of lessons distributed per educational level and country

Country	Age group			
	Preprimary	Primary	Secondary	Total
UK	12	10	6	28
Germany	2	6	12	20
Portugal	5	8	8	21
Cyprus	13	6	0	19
Spain	9	8	6	23
Total	45	34	32	111

signed consent forms allowing their voluntary participation in the project. In the few cases in which a student's participation was not approved for video recording, the child's image was blurred in the whole-class video, and the small group to which the child belonged was not chosen for data collection purposes. For each observed class, two groups were randomly selected to form part of the data collection process during small-group discussions, with one of them being used for transcription and analysis purposes and the other serving as a back-up. As we did not have to use the back-up groups in none of the cases, all 111 lessons include discussions from the same small group per class.

The interactions were transcribed verbatim using a simplified adaptation of Jefferson's conventions, as explained in detail in Rapanta et al. (2021a) and were translated into English by professional translators when English was not the language used. When transcribing, codes were used to replace schools', teachers', and students' names since the very beginning of data treatment, to guarantee anonymity. The constructed multilingual and multi-country corpus (available at Rapanta et al., 2021a) was annotated using a validated coding scheme focusing on dialogicity/other-orientedness (Macagno et al., 2022). This study focuses only on students' 'Reasoning' moves, defined as moves expressing any type of 'justifications in support of a viewpoint' (ibid, p. 122).[1] For an overview of all types of emerging discourse moves in the same corpus' see Rapanta et al. (2023), as well as Table 6.

Data analysis

Arguments' identification, especially among young children, is not easy. As other researchers have observed, children and adolescents tend to produce arguments that are incomplete (Anderson et al., 1997), with several elements remaining implicit (Convertini & Arcidiacono, 2021), and many times they produce pseudo-justifications or pseudoevidence, rather than valid arguments, of the type 'I think they should perform an abortion because this pregnancy must be terminated' (Zohar & Dori, 2003, p. 165) or 'Prisoners return to crime because they prefer life in prison (…) when they're in prison, they are secure' (Kuhn, 1993, p. 80).

To address the above challenge, we adopted a discourse-based approach of identifying arguments, taking into consideration the pragmatic context of interaction (including lesson plan, age, social framing, etc.). As Auriac-Peyronnet (2001) also explains, 'a somewhat functional (discursive model) rather than a formal approach (textual schema) is adopted' (p. 301). Our major problem was to distinguish between narrative-explanatory structures

[1] For this study, we compressed the 'Reasoning' and 'Metadialogical reasoning' categories under one unique category representing arguments.

from arguments. So far, important distinctions have been made between the two discourse functions by scholars from both education and philosophy. For example, Ebel (1981) distinguished between explicative and argumentative discourse, with the former being designed to take for granted the truth, or at least the objectivity, of what is explained. On the contrary, Coirier & Golder (1993) explain that 'argumentation does not entail stating "why such and such is the case", but rather "why I feel it is preferable that such and such is the case"' (p. 170). That said, in argumentative discourse, there is an evaluative or enunciative element completely missing from explanation. Osborne & Patterson (2011) take a step further to describe the function of an explanation as one of making sense of a feature or phenomenon that is not in doubt, whereas the function of the argument is to justify a claim that is questionable; often such questionability refers to the selection of the best explanation itself; therefore, the two, argument and explanation, co-exist.

The aforementioned pragmatic approach (for the role of the overall dialogical context regarding the interpretation of each utterance, see also Sacks et al., 1974) was used for assessing whether a child has uttered an argument or an explanation. However, the distinctions drawn by the literature, as previously described, were not completely sufficient. This was a crucial challenge characterizing our data, coming from a classroom interaction context where students had to interpret a specific text (see Context above) guided by the teachers' prompts. In this scenario, an interpretation of a text can be either argumentative or information-providing, depending on the type of activity that the teachers propose through their questions (Rapanta & Macagno, 2023)—whether authentically leaving the students the possibility of supporting a possible original explanation, or guessing the teachers' preferred answer. A clear example can be drawn from one of our programme's lesson plans, in which one of the central questions was why the Baboon (i.e. the central character of the film) was crying. Several interpretations were possible such as the following: because he was away from his home, because he was missing his family and friends, because he was feeling lonely, etc. Students' utterances expressing an explanation backed by one reason (datum) were thus coded as arguments. In contrast, in other cases, this interpretative element was absent; therefore, students' reasoning structures were not coded as arguments. For example, in a different lesson plan, one of the teachers' guiding questions to help younger children understand the film was why the big Ant was whistling. This question, however, only had one correct answer: because he was the leader Ant. For this reason, students' replies were not coded as arguments, as they merely provided information and not justified explanations.

Once all students' arguments were identified in the multilingual corpus described above, we coded their present elements according to Toulmin's (1958) argument pattern (Fig. 1). This is a schematic philosophical tool describing each argument with the same generic elements, consisting of the claim (or conclusion), the data (some factual premises) that support the claim, a warrant (inferential rule) that logically and generally connects the data with the claim, the backing that provides substantial evidence that the argument (claim-data-warrant) is true or plausible, the qualifiers that moderate the degree of the argument's plausibility, and the rebuttal, which corresponds to the acknowledgment of a limitation of one's own argument in monological argumentation (Toulmin, 1958), or a counterargument or a refutation (i.e. a reply to a counterargument) in dialogic argumentation (Kuhn, 1991; Leitão, 2000). Toulmin's argument pattern provided the basis for the identification of two types of argument quality, according to their structure, namely (a) argument complexity, i.e. the degree to which students' arguments just manifest a 'skeleton' argument pattern, composed of a claim supported by data and a warrant (not always explicit), or whether they go beyond this, through incorporating backings (external evidence), qualifiers (argument epistemic modalities), or even rebuttals (counterarguments or

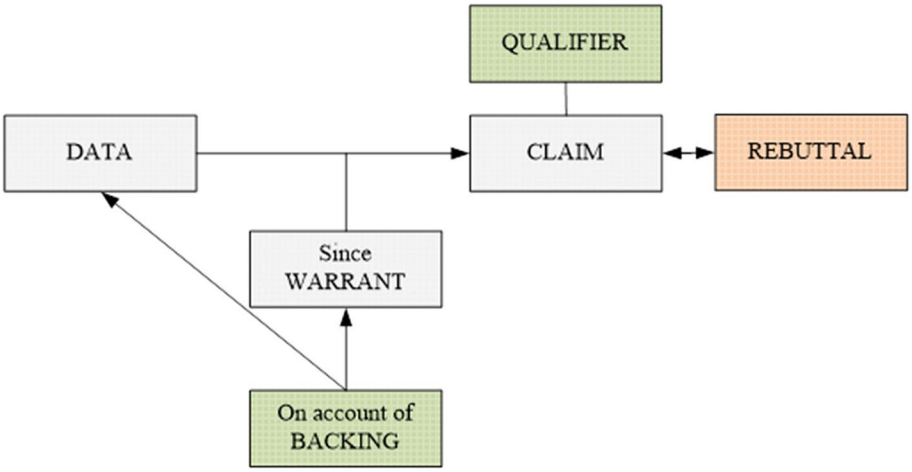

Fig. 1 Argument structure (modified version from Toulmin, 1958). Note: core elements in grey, and extension elements in green and orange

replies to counterarguments); and (b) argument explicitness, i.e. the number of argument elements made explicit in discourse.

Toulmin (1958) distinguished three elements that increase the complexity of an argument, namely the qualifier, the backing, and the rebuttal (explained above). The use of the distinct elements that are an extension of the skeleton pattern reveal different argumentative skills, therefore different levels of complexity. The use of evidence as a backing to support a claim reveals students' epistemological awareness (Sandoval & Millwood, 2005). Similarly, the use of qualifiers (e.g. 'most probably', to a certain degree'), largely corresponding to epistemic modals (Rocci, 2019), reveals an advanced knowledge of the epistemological norms guiding argumentation such as the awareness of the uncertainty and defeasibility of the conclusion. Therefore, the presence of backings and qualifiers may be considered a higher level of complexity than the use of claims, data, and warrants alone. Finally, the use of rebuttals is even more complex (Foong & Daniel, 2010) as it may manifest two distinct kinds of sophisticated argumentative skills: a dual perspective, in which another's opposing point of view is taken into account, or an integrative one, which consists in weighting pro and con arguments in the presentation of a viewpoint (Felton & Kuhn, 2001; Kuhn & Crowell, 2011; Kuhn & Udell, 2007; Nussbaum, 2021). Therefore, the use of Rebuttals corresponds to the highest level of complexity (Mayweg-Paus et al., 2016; Kuhn et al., 2000). Table 3 shows examples of a low, medium, and high complexity arguments, as emerged in the analysed corpus.

The degree of explicitness of an argument depends on whether an argument provides the elements necessary for its full understanding and interpretation or leaves some elements implicit that may affect the reconstruction of the argument. Clearly, depending on whether the argument mirrors a skeleton pattern (data, claim, warrant—low complexity) or includes evidence (backing—medium complexity) and/or a different perspective (rebuttal—high complexity), its elements are different, and thus the requirements affecting its expression. While a low complexity argument (characterized by a core structure) is complete and fully understandable if it manifests data and claim and is very explicit if the warrant (or the qualifier) is expressed, the case of medium and high complexity arguments is different. Backed-up arguments require the interpretation of the evidence to be fully understood—and signal

Table 3 Examples of students' arguments classified by their level of complexity

Level 1 (low complexity)
T: And why does his dad want him—what do you—why do you think his dad wants him to be a fighter? S: Teacher, because he's a man!
Level 2 (medium complexity)
S: The boy wanted a dancer's room. The boxing gloves were like that leaning against a corner because he didn't want the boxing gloves, he wanted things like him ahm like ballet toys, some ballet skirt, I don't know…
Level 3 (high complexity)
Everyone has the same [rights]! Um, yeah, so. Not everywhere there though, yeah, I mean, if you look at Germany then yes, we all have the same rights. But when you look further then they have different rights than we do here. If we go worldwide, then it's different once again

the capacity to coordinate theory and evidence and communicate it (Kuhn, 2002). In contrast, arguments involving rebuttals do not need to be fully explicit, as the manifestation of an attack is already a sufficient expression of the capacity to take into account and critically address another's viewpoint (Nussbaum & Edwards, 2011). For the reasons above, the levels of explicitness have been classified as follows (Table 4).

Examples of students' arguments of a low, medium, and high explicitness are presented in Table 5. Note that all three examples are of a medium complexity (backing but not rebuttal present).

These examples also illustrate how the notion of explicitness used in this study is different from Grice's (1975) conversational notion of sufficient and necessary quantity of information to be conveyed for a message to be suitable for a talk exchange. As it can be illustrated in the children's arguments presented in Table 4, all three instances make sense from a conversational point of view, as they are as informative as is required for allowing the interlocutor to understand what is meant. However, an exchange of information is different from an argumentative discussion, where the goal is to address a difference of opinions by

Table 4 The dimensions of argument explicitness and complexity and their relations (*C* claim, *D* data, *W* warrant, *B* backing, *Q* qualifier, *R* rebuttal)

	Low complexity	Medium complexity	High complexity
Low explicitness	C or D	B or CB	
Medium explicitness	CD or WD or WC	DB or WB or BQ	R
High explicitness	DWC, or DDC	CDB or WDB or DBQ	RC/RD/RB/RQ

Table 5 Examples of students' arguments classified by their level of explicitness

Level 1 (low explicitness)
[*The baboon was born on the moon]* Because {when the movie started} he was already sleeping there. (B)
Level 2 (medium explicitness)
[*The baboon regretted being on the moon*] Because… […] because he was playing the trumpet […] it seems like he was calling people on Earth. (DB)
Level 3 (high explicitness)
I think he was from the moon because if he doesn't have a helmet it is because he was born on the moon and can breathe there! So, when he looked at Earth, I think it was just a planet that he wanted to know. (C + B + D + BD)

increasing the acceptability of one's viewpoint (Walton, 1990). For an argument to be persuasive and thus pursue its goal to solve a doubt, a challenge, or an opposing perspective, the premises or elements that can be controversial or can be interpreted in different ways need to be made explicit (Walton, 2001, 2008). For this reason, argument 3 in Table 4 containing two data, two backings, and a claim is of the highest level of explicitness.

Finally, we were also interested in the different functions that children's and adolescents' arguments serve. To this purpose, all the argumentative excerpts were coded by classifying them as an instance of an argumentation scheme (Walton et al., 2008). Argumentation schemes are prototypical schematic representations of the most common types of arguments used in everyday language. Although Walton et al. (2008) describe 60 such schemes, in a recent large corpus analysis (Rapanta, 2022), the argumentation schemes were reduced to 13 types, which include the nine most emerged types in our corpus (see Table 15 in the Appendix for a definition and example of each). The identification of the argumentative function as represented by the corresponding scheme complements the structural analysis as it allows researchers to understand the content and nature of the underlying reasoning.

All three kinds of argument quality assessment measures identified above (namely complexity, explicitness, and type of argument function) directly relate to identifiable argumentation skills, as emerging in social contexts. For instance, at the level of complexity, the use of more sophisticated elements such as backings, qualifiers, and rebuttals reveals the use of more advanced argument skills, related to the understanding, use, and coordination of evidence, as explained above. Similarly, the different degrees of argument explicitness reveal a specific type of strategic argument competence, as it shows that the speaker is aware of the possible misunderstanding, unclarity, or risks of attacks and criticisms resulting from leaving specific elements unexpressed. Finally, the preference for one type of argumentation scheme over another defines a speaker's argumentation profile (Rapanta, 2022; Hansen & Walton, 2013), which can reveal the extent to which a speaker uses more critical and complex reasoning patterns or instead tends to opt for other strategies (such as attacks or more heuristic types of argument).

Coding reliability

The two authors double-coded blindly to each other a randomly selected part of the corpus representing different countries and age levels and being equal to approximately 20% of the whole data. We assessed inter-coder reliability on the following variables: (a) TAP elements, namely claim, data, warrant, backing, qualifier, and rebuttal, with a satisfying result ($a = 0.76$)[2]; (b) argument complexity, with a very satisfying result ($a = 0.87$); (c) argument explicitness, with a very satisfying result ($a = 0.91$); and (d) argumentation schemes, with a satisfying result ($a = 0.72$).[3] After we resolved all disagreements among us, the second author proceeded to the coding of the rest of the corpus.

It is also important to note that although the identification of the reasoning moves was initially done by the partner teams in their local languages (see Rapanta et al., 2023), the argument analysis and coding described in this paper was done in the English version of the corpus but always contrasting with the original version, when different. The second author performed the necessary verifications in the original language for the German (B2

[2] The lowest scores were for "data" ($a = 0.68$) and "backing" ($a = 0.67$), probably because of a difficulty in distinguishing between the two at several of the coded instances.

[3] The lowest scores were for Argument from Consequence ($a = 0.66$), Cause Effect ($a = 0.68$), Argument from Sign ($a = 0.65$), and Argument from Values ($a = 0.64$), possibly because of confusion between these categories (the first two with each other, and the latter two with each other).

level of proficiency) and Portuguese (C1 level of proficiency) data, while the first author for the Spanish (C1 level of proficiency) and Cypriot data (native speaker).

Findings

RQ1. When do arguments mostly emerge? During a whole-class or a small-group discussion?

Just looking at the number of arguments emerged during one type of activity or another, a prevalence of whole-class discussions over small-group activities is evident as the type of social framing that invokes more student reasoning to take place. As shown in Table 6, out of 2836 student moves coded as 'Reasoning' moves (corresponding to arguments), more than half ($n=1918$, or 68%) were produced in whole-class discussions, while the remaining 918 (32%) emerged during small-group discussions. This difference was statistically significant according to the adjusted residuals' calculation, and along with other significantly different moves' distribution (namely 'managerial', 'state', 'accept/discard', and 'invite'), was responsible for a significant Pearson chi-square value [$\chi^2(6)=3064.706$; Cramer's $V=0.331$; high effect size] confirming the dependency between the 'activity type' and 'type of move' variables.

To further analyse the association between activity type and emergence of reasoning moves, we performed two additional chi-square analyses: one was intended to explore whether the social framing of interaction is associated with student arguments' complexity (Table 7), while the other aimed at inquiring whether the social framing is related to student arguments' explicitness (Table 8). Results were statistically significant in both cases, showing an association between activity type and argument quality, but with a small effect size for complexity [$\chi^2(2)=90.500$, Cramer's $V=0.18$], and a tiny effect size for explicitness [$\chi^2(3)=8.502$, Cramer's $V=0.05$]. An important difference between the two dimensions needs to be highlighted: while a significant majority (according to the adjusted residuals' calculation) of highly explicit arguments (three elements and above) emerge in whole-class discussions, highly complex arguments significantly emerge in small-group settings and low-complexity arguments in whole-class settings.

RQ2. What kinds of arguments do children and adolescents make? What is their structural and functional quality?

We found differences between the three age groups (preprimary, primary, and secondary education) when we considered the quality of arguments produced by students. Our analysis showed that there is a statistically significant association between age group and (a) level of argument complexity [$\chi^2(4)=129.475$, significant at $p<0.05$, Cramer's $V=0.15$; small effect size], (b) level of argument explicitness [$\chi^2(6)=148.387$, significant at $p<0.05$, Cramer's $V=0.16$; small effect size], and (c) type of argumentation scheme (i.e. argument function) [χ^2 $(14)=188.791$, significant at $p<0.05$, Cramer's $V=0.18$; medium/large effect size], as shown on Tables 9, 10, and 11 correspondingly. The association between argument scheme type and age group is best depicted in Fig. 2, where we can see that preprimary is associated with argument from consequences (AC), argument from practical reasoning (PR), argument from values (AV), and other. The remaining argument types are associated with secondary and primary, with primary being more associated with argument from sign (AS) and cause-effect (CE), and secondary with argument from best explanation (BEX), analogy (AA), definition (DEF), and example (EXAM).

Table 6 Crosstabulation between 'activity type' and 'type of move'

			Move type							Total
			Managerial	State	Accept/discard	Expand	Invite	Metadialogical	Reasoning	
Activity type	Whole class	*n*	1400	7362	949	1410	698	780	1918	14,517
		%	29%	67%	30%	53%	35%	50%	68%	52%
	Small group	*n*	3362	3633	2195	1246	1286	767	918	13407
		%	71%	33%	70%	47%	65%	50%	32%	48%
Total		*n*	4762	10,995	3144	2656	1984	1547	2836	27,924[1]
		%	100%	100%	100%	100%	100%	100%	100%	100%

[1]For this analysis, we excluded the moves coded as 'irrelevant or uncoded' due to noise, incompleteness or off-task activity

Table 7 Crosstabulation between 'activity type' and level of argument complexity'

			Level of argument complexity			Total
			Low	Medium	High	
Activity type	Whole class	*n*	1279	458	181	1918
		%	72%	69%	47%	68%
	Small group	*n*	507	205	206	918
		%	28%	31%	53%	32%
Total		*n*	1786	663	387	2836
		%	100%	100%	100%	100%

Table 8 Crosstabulation between 'activity type' and 'level of argument explicitness'

			Level of argument explicitness				Total
			One element	Two elements	Three elements	Four elements and above	
Activity type	Whole class	*n*	697	941	239	41	1918
		%	67%	67%	73%	79%	68%
	Small group	*n*	351	468	88	11	918
		%	33%	33%	27%	21%	32%
Total		*n*	1048	1409	327	52	2836
		%	100%	100%	100%	100%	100%

Table 9 Crosstabulation between 'age group' and 'level of argument complexity'

			Level of argument complexity			Total
			Low	Medium	High	
Age group	Preprimary	*n*	594	129	50	773
		%	33%	20%	13%	27%
	Primary	*n*	774	293	166	1233
		%	43%	44%	43%	44%
	Secondary	*n*	418	241	171	830
		%	24%	36%	44%	29%
Total		*n*	1786	663	387	2836
		%	100%	100%	100%	100%

RQ3. What are some identified developmental trends in socially emerging argumentation skills, as manifested in different age and cultural contexts?

The above across-age differences should be situated within the cultural context in which they were produced. As the only culture-related information we had for the student participants (in some of the participating countries it was not possible to have access to other, more sensitive information regarding students) was the country of residence, we compared the three argument quality indicators (complexity, explicitness, and function)

Table 10 Crosstabulation between 'age group' and 'level of argument explicitness'

			Level of argument explicitness				Total
			One element	Two elements	Three elements	Four elements and above	
Age group	Pre- primary	*n*	412	316	39	6	773
		%	39%	22%	12%	11%	27%
	Primary	*n*	392	663	150	28	1233
		%	38%	47%	46%	54%	44%
	Secondary	*n*	244	430	138	18	830
		%	23%	31%	42%	35%	29%
Total		*n*	1048	1409	327	52	2836
		%	100%	100%	100%	100%	100%

Table 11 Crosstabulation between 'age group' and 'argumentation scheme type' (*AC* argument from consequences, *CE* cause effect, *DEF* definition, *EXAM* argument from example, *PR* argument from practical reasoning, *AV* argument from values, *BEX* argument from best explanation, *AS* argument from sign, *AA* argument from analogy)

			Argumentation scheme type									Total
			AC	CE	DEF	EXAM	PR	BEX	AS	AA	Other	
Age group	Pre- primary	*n*	112	174	42	54	57	147	86	82	19	773
		%	56%	24%	22%	23%	45%	21%	23%	33%	44%	27%
	Primary	*n*	50	365	76	85	37	302	177	122	16	1230
		%	25%	52%	40%	36%	29%	43%	47%	49%	37%	44%
	Secondary	*n*	37	168	74	97	33	250	115	46	8	828
		%	19%	24%	38%	41%	26%	36%	30%	18%	19%	29%
Total		*n*	199	707	192	236	127	699	378	250	43	2831[1]
		%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

[1] $N = 2831$, because five arguments did not have enough premises explicit to allow for a categorization

across the five countries (UK, Portugal, Germany, Spain, and Cyprus). All associations between 'country' and the three argument quality indicators were significant [for complexity: $\chi^2(8) = 60.108$, significant at $p < 0.05$, Cramer's $V = 0.10$, small effect size; for explicitness: $\chi^2(12) = 102.427$, significant at $p < 0.05$, Cramer's $V = 0.11$, small effect size; for function: $\chi^2(32) = 360.438$, significant at $p < 0.05$, Cramer's $V = 0.18$, medium/large effect size] (Tables 12, 13 and 14). The differences in frequencies of the most used argumentation schemes (Table 14) show that the country effect overcomes the age group effect, as most of the arguments produced by children in the UK were best explanations, while most of the arguments produced by adolescents in Germany (see Table 1 for students' distribution per country and age group) were cause-effect arguments, in contrast with the age-related tendencies described in the previous section (see Table 11). This finding led us to perform some additional analyses to identify the possible interferences between the three independent variables, namely age group, social setting, and country.

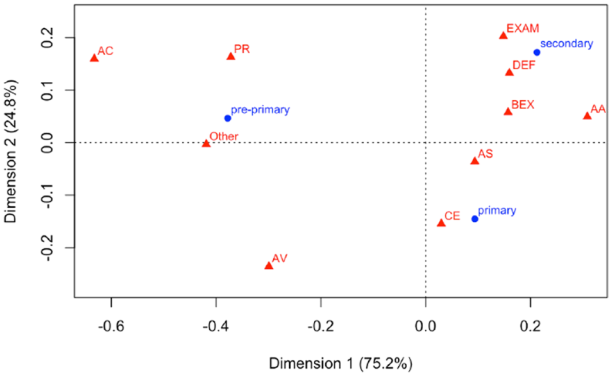

Fig. 2 Correspondence analysis of the data in Table 11. Correspondence analysis is a technique for reducing multivariate data to a smaller number of explanatory dimensions that retain as much as possible of the original variance (Jenset et al., 2012). The most important dimensions (as determined by percent explained variance) can be interpreted visually in a two-dimensional plot, where the proximity of variables indicates association. Our analysis used the *ca* package (Nenadic & Greenacre, 2007) and the first two dimensions cover 100% of the original variance meaning that they are an excellent representation of the full data

For the analysis of the presence of interactions between the predictors or independent variables, we used conditional inference trees, as implemented in the R *party* package (Hothorn et al., 2006). Conditional inference trees are effectively a type of non-parametric regression model (Hothorn & Everitt, 2006), where the response variable is successively split according to a recursive partitioning algorithm that seeks to optimize the response variable splits conditional on the predictor variable values. Conditional inference trees can be visualized and read as a decision tree with binary splits, where the variable values associated with branches are splitting criteria. The trees can be read top down, where the topmost node is the most important predictor, and where nesting of variables at successive levels represent interactions. The leaf nodes at the bottom of the tree represent the response variable outcomes for the combination of predictor values in the branches above it. Conditional inference trees are sometimes used alongside regression models (Tagliamonte & Baayen, 2012), since these classes

Table 12 Crosstabulation between 'country' and 'level of argument complexity'

			Level of argument complexity			Total
			Low	Medium	High	
Country	UK	*n*	523	239	139	901
		%	29%	36%	36%	32%
	Portugal	*n*	244	89	64	397
		%	14%	13%	17%	14%
	Germany	*n*	201	103	62	366
		%	11%	15%	16%	13%
	Spain	*n*	424	149	79	652
		%	24%	23%	20%	23%
	Cyprus	*n*	394	83	43	520
		%	22%	13%	11%	18%
Total		*n*	1786	663	387	2836
		%	100%	100%	100%	100%

Table 13 Crosstabulation between 'country' and 'level of argument explicitness'

			Level of argument explicitness				Total
			One element	Two elements	Three elements	Four elements and above	
Country	UK	*n*	265	471	135	30	901
		%	25%	33%	41%	57%	32%
	Portugal	*n*	152	191	49	5	397
		%	15%	14%	15%	10%	14%
	Germany	*n*	105	199	57	5	366
		%	10%	14%	18%	10%	13%
	Spain	*n*	313	282	50	7	652
		%	30%	20%	15%	13%	23%
	Cyprus	*n*	213	266	36	5	520
		%	20%	19%	11%	10%	18%
Total		*n*	1048	1409	327	52	2836
		%	100%	100%	100%	100%	100%

Table 14 Crosstabulation between 'country and 'argumentation scheme type' (*AC* argument from consequences, *CE* cause effect, *DEF* definition, *EXAM* argument from example, *PR* argument from practical reasoning, *AV* argument from values, *BEX* argument from best explanation, *AS* argument from sign, *AA* argument from analogy)

			Argumentation scheme type									Total
			AC	CE	DEF	EXAM	PR	BEX	AS	AA	Other	
Country	UK	*n*	41	211	96	94	21	253	98	60	26	900
		%	21%	30%	50%	40%	17%	36%	26%	24%	61%	32%
	Portugal	*n*	23	58	28	23	14	173	54	16	6	395
		%	12%	8%	15%	10%	11%	25%	14%	6%	14%	14%
	Germany	*n*	20	111	23	22	6	92	58	29	4	365
		%	10%	16%	12%	9%	5%	13%	15%	12%	9%	13%
	Spain	*n*	47	162	27	62	40	147	96	65	6	652
		%	23%	23%	14%	26%	31%	21%	26%	26%	14%	23%
	Cyprus	*n*	68	165	18	35	46	34	72	80	1	519
		%	34%	23%	9%	15%	36%	5%	19%	32%	2%	18%
Total		*n*	199	707	192	236	127	699	378	250	43	2831[1]
		%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

[1] $N = 2831$, because five arguments did not have enough premises explicit to allow for a categorization

of models complement each other to some degree. In our case, this seemed less useful, since the response variables we are interested in are multivariate, not binary. We believe that conditional inference trees are a better class of models for our data, and they lend themselves more readily to interpretation than multivariate logistic regression models.

According to the conditional inference trees produced (see Figs. 3 and 4 in the Appendix), the most important predictor for complexity is age, where the preprimary group has a clear preference for low-complexity arguments. For the primary and secondary groups, the picture

is more nuanced and depends on the class activity. In small-group settings, we see a distinction: the primary group prefers complexity level 1, while the secondary group has a more even distribution of complexity levels. In whole-group settings, there is a country effect: in Cyprus and Spain, the primary group seems to have a higher proportion of level 1 complexity, in effect mirroring the small-group pattern described above, whereas for Germany, Portugal, and UK, there seems to be no age effect in the whole class setting (Fig. 3 in the Appendix). When it comes to argument explicitness, again age is the most important predictive variable. For the preprimary group, there is a country effect where Spain seems to have an almost equal proportion of level 1 and level 2 explicitness, whereas in the other countries level 1 dominates. For the primary and secondary groups, there is again a dependency on activity. Small-group activity is dominated by level 1 and 2 explicitness (with level 2 being slightly preferred), while in the whole-class setting, there is a country effect (Cyprus and Spain stand out again), and an age effect within Germany, Portugal, and the UK (Fig. 4 in the Appendix).

Discussion

Among the findings reported above, we identify three tendencies that deserve our further attention and discussion. First, primary school students' arguments show an irregular argumentative behavior, as sometimes it is comparable with the one characterizing younger students, and sometimes with the adolescents' one. Second, the cultural context (country of residence) appears to have an effect on the structure and function of argumentative reasoning. Finally, the data suggest that the social setting (small-group versus whole-class discussion activity) may have an effect on the number and quality of arguments produced. We will discuss each of these findings separately, followed by some limitations of the present study.

Age effect

Although, in general, a developmental tendency in argumentative reasoning was confirmed, our analysis identified a somehow irregular argument behaviour among primary school students (on average, 9 years old). Primary students produced more complex arguments than preprimary school students and much less than adolescents (Table 9); however, the primary students' behavior at the level of argument explicitness is more similar to the adolescents' one, and the difference with younger children is more evident (Table 10). Regarding the argumentation function/scheme preferred, primary students' arguments follow the trends characterizing adolescents' arguments (Fig. 2), although with some distinct preferences between them. These findings in combination may indicate that pre-adolescence children are situated in between a minimal and an elaborated argumentation stage (Coirier & Golder, 1993). On one hand, they show difficulties that characterize younger children's behavior, probably because of their 'inability to co-ordinate two different dimensions' and the 'absence of simultaneous control of the textual/linguistic and discursive/cognitive constraints' (Auriac-Peyronnet, 2001; p. 313). Although they produce arguments that have a more complex structure than the arguments produced by younger children, still their percentage of highly complex arguments is relatively low, as compared to adolescents. This can be explained as a difficulty in using more advanced argument elements, such as rebuttals (counterarguments and refutations), which is a skill attained later on (Coirier & Golder, 1993). On the other hand, primary students show the capacity to (strategically) make the necessary argument elements explicit, showing an argument behaviour resembling the one of adolescents. This may be due to some

previously observed disparity of individual differences in children from nine to 13 years old (Clark & Delia, 1976, p. 1013, observe that 'One eighth grader used a total of 33 different arguments, while another member of the same class used 5'). Coirier & Golder (1993) also found that among 7–8-year-olds, there were three highly distinct groups in terms of argument skill: 'those who did not support their position (10%), those who produced the minimal argumentative structure, but nothing more (approximately 40%), and those who connected their arguments, and thus achieve the adult level (25%)' (p. 179).

Country effect

According to the age group distributions per country (Table 1), we would expect similarities in the type of reasoning between UK and Cyprus, and between Portugal and Germany. However, this was not the case. UK- and Portugal-based students produced more arguments from best explanation, which was expected for Portugal-based students (mostly adolescents), but not for UK-based students (mostly young and older children). Germany- and Cyprus-based students produced more arguments from cause-effect, which was expected for the Cypriot sample (mostly children), while not for the German one (mostly adolescents). A possible explanation of this discrepancy is an effect due to the cultural context in the specific cases of UK and Germany. UK-based students' predominant preference for best explanations may be attributed to the fact that a big majority of the participant schools in the project had previously participated in similar projects stimulating dialogue in the classroom. It is therefore possible that the participant teachers from UK were more prompt to model this type of advanced reasoning (best explanations are the most complex pattern of abductive reasoning) than other participant teachers. Germany's preference for cause and effect can be explained in terms of the country's high pragmatism; according to Hofstede et al. (2010), countries such as Germany are pragmatic in the sense that people believe that truth highly depends on the situation, context, and time. Similarly, the presence of highly explicit arguments within the British and German lessons may be related to the fact that these cultures show a preference for low-context communication, meaning that they tend not to take the common cultural ground into account and, therefore, they need to make information as much detailed as possible (Hall & Hall, 1990).

Framing effect

The type of social setting framing the interaction, namely small-group or whole-class discussion, was also significantly associated with the quality of arguments produced by young students, especially for the primary and secondary groups. However, the framing effect was more evident for whole-class discussions, also indicating a country effect according to the further analysis we performed (see Figs. 3 and 4 in the Appendix). This combination of whole-class setting and country effect may indicate the role of teachers' mediation in the emergence of high-quality arguments (in terms of complexity and explicitness) and the different degrees of teachers' preparedness between the participant countries. Several studies confirm that for high-quality classroom argumentation to emerge, teachers must act as 'floor-keepers', scaffolding students' reasoning, but without substantially intervening in the reasoning process, therefore allowing students to progressively interanimate their ideas (Clarà, 2019; Wells & Arauz, 2006). This active–passive teachers' stance[4] is not easy to

[4] In Reznitskaya & Gregory's (2013) words, dialogic teachers must be 'substantively weak' but 'procedurally strong' (p. 117).

achieve, and it is possible that in some cases country-based teacher professional development (PD) on the use of dialogue and argumentation in the classroom was not enough. To further confirm this result, future research must take into account previous PD experiences of the participants related to teaching through dialogue and argumentation.

Contribution

Knowing the specific conditions under which argumentative reasoning skills manifest the most is an asset for educators and researchers alike. The revised literature on argument development and educational argumentation leaves an important gap when it comes to methods of assessing the production of oral arguments by children and adolescents. Several questions are left unanswered such as the following: At what age do children start manifesting more advanced argument skills? Do dialogue setting and social framing of interaction interfere in this manifestation? How is the cultural context related to argumentative reasoning? In this methodological paper, we present a comprehensive framework for identifying and analyzing young people's arguments, including preschool children, as they emerge in oral dialogic discussions about social issues. Not only were we able to apply the framework across ages and dialogue settings (whole-class, small-group) but also across different cultural contexts, using a multi-country corpus of a large European project. Our large-scale analysis revealed several trends worthy of further attention such as advanced argument reasoning skills of 9-year-olds, mediated effect on argument complexity of peer-to-peer discussions, and potential influences of the country of residence on 'cultural' ways of arguing.

Limitations

A first limitation of our study concerns the fact that we did not have any data regarding the previous PD experience of teacher participants in dialogue and argumentation-related pedagogies. Only informally, we know that UK-based teachers in our sample were all previously invited to participate in similar projects and most of them did. Given the interference of country effect for the whole-class discussions when it comes to argument complexity and explicitness, we consider that future work must look more closely at teachers' preparedness for guiding dialogic discussions.

Our second study limitation concerns the interpretation of findings related to country-based differences in the use of argumentation schemes. Although there is much recent research that aims to unveil the influence of country of origin on dispositions towards arguing (Rapanta & Hample, 2015; Kuhn et al., 2010; Lewiński et al., 2018), we must be very cautious when making any assumption related to cross-cultural differences in any type of psychological research. This is mainly because the term 'culture' has several levels and factors that cannot be limited to a person's country of origin. In fact, as Huber & Reynolds (2014) affirm, cultural identities and affiliations are a matter of personal preference and experience extending, and often prevailing, the number and type of ascribed identities including ethnicity. Just attributing the name of a country to a learner according to where their school is located does not say much about the person's culture. However, we did find that, in general, the ethnical-cultural framing of discussions does play a role in the type and structure (complexity and explicitness) of the arguments produced. It is, therefore, necessary to shed more light on the great array of sociocultural framing factors that may influence the quantity and quality of learners' arguments, to support students in their as much situated as possible expression and development of argumentation skills.

Appendix

Please see Table 15.

Please see Figs. 3 and 4.

Table 15 Argumentation schemes used for codifying the corpus

Argumentation scheme	Description	Example from the corpus
Argument from cause to effect	Supports the prediction of an effect based on the occurrence of its cause	Like I don't know, I don't know how to explain […] {unclear} when I was a child I went through BAD experiences my personality will change […] like […] attitudes {unclear}
Argument from definition	Supports the classification of a state of affairs or entity (or rejection thereof) based on a definition or definitional criterion	YOUR HOUSE is a place where you feel comfortable, it doesn't necessarily have to be the house you bought!
Argument from example	Supports a generalization by showing a specific (paradigmatic) instance thereof	Let's see, so, there's a lot of people leaving the country, like…. either they want to make money in other countries…or…. I can put an example which is current affair, it is what is happenning in Greek culture, they had to leave {unclear} and now they don't have a home
Argument from consequences	Supports or discourages a course of action by considering its positive or negative consequences	And no- And you can't play, otherwise nobody has time to do anything
Argument from practical reasoning	Supports a course of action by presenting it as the best means to pursue or achieve a desired end or goal	(…) so, he thought that the best thing, the best idea, the best way to solve the {problem} was [to escape the problem
Argument from values	Supports the classification of an action or state of affairs as desirable or not based on values and hierarchies thereof	Because he really liked it… there's lots of animals there
Argument from best explanation	Provides the explanation of a phenomenon by selecting the best one, either comparing between different types of explanations, or providing evidence against possible alternative hypotheses	Ahm there are different films, different places, for example, this one seems to be. But, in this example, it is in India because there is that […] idea of the flying carpet and the stork that brings the children, because in the middle we see a […] it is not an orchestra, but a group playing a type of music that is traditionally more in North America. And {unclear} the recording of a film from those of the 60 s, more of Westerns and horses and cowboys

Table 15 (continued)

Argumentation scheme	Description	Example from the corpus
Argument from sign	Supports the occurrence of a specific cause of a phenomenon by pointing out its usual effect	So the baboon was born in Africa because when it looked at Africa it started to cry and in its room there were things that came to say that it was from Africa, like for example a poster from Mali and its appearance reminds us of the African tribes then here comma
Argument from analogy	Supports the attribution of a characteristic to a subject (the Target) by showing that another subject (the Analogue) sharing a relevant similarity with it has this specific characteristic	I also agree with S5 because that happens in families too, that the parents want something different to the children and that the parents {then} do a different sport and the children are supposed to do it too, but they actually don't like it at all, instead they like something else that the parents don't really want. That happens in Germany too, {unclear} {a lot even} I think

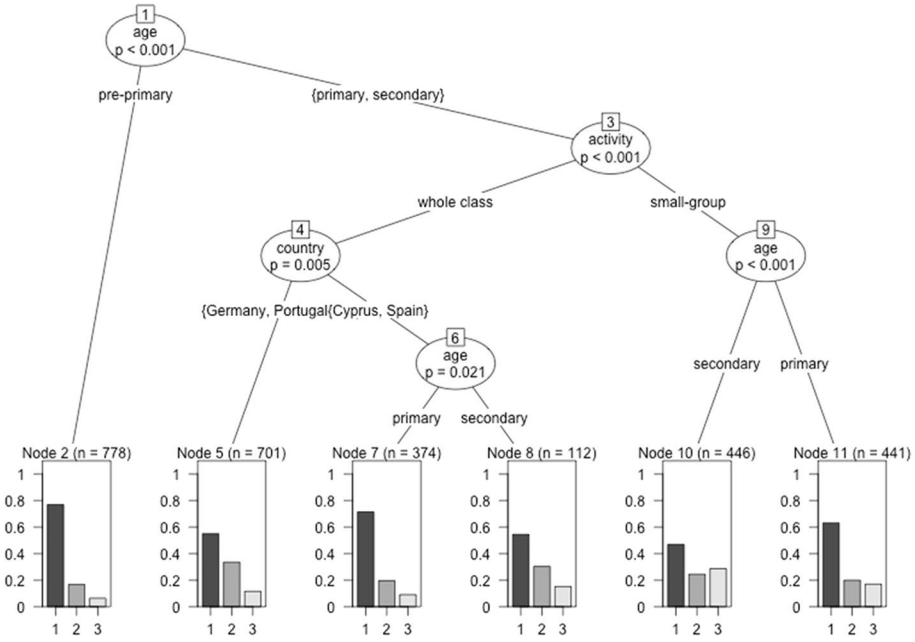

Fig. 3 Conditional inference tree with age group as the main predictor for argument complexity levels 1, 2, and 3

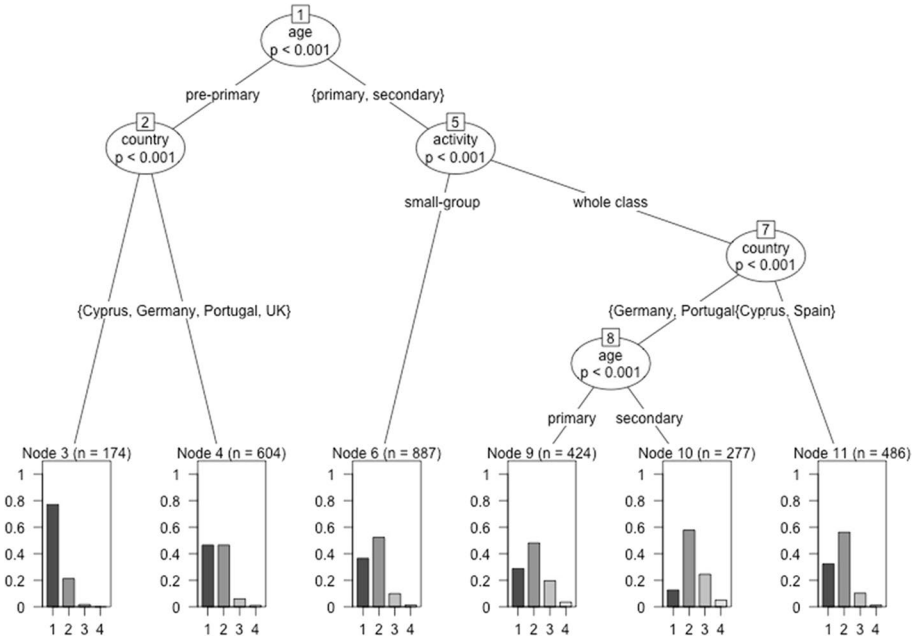

Fig. 4 Conditional inference tree with age group as the main predictor for argument explicitness levels 1, 2, 3, and 4

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Data Availability The original corpus referred to in this study is published as an open-access data article here: https://doi.org/10.1016/j.dib.2021.107518.

Declarations

Conflict of interest The third author is employed by Springer Nature in a non-editorial role and carried out this research in a personal capacity. He has not played any editorial role in the handling of this manuscript. Similarly, the other two authors do not declare any conflict of interest.

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