Argumentation and Education

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Editors

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Theoretical Foundations and Practices

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Introduction

Nathalie Muller Mirza and Anne-Nelly Perret-Clermont

Argumentation constitutes an important dimension of daily life and of professional activities. It also plays a special role in democracies and is at the heart of philosophical reasoning and scientific inquiry. Argumentation has an increasing importance in education, not only because it is an important competence that has to be learned, but also because argumentation can be used to foster learning in philosophy, history, sciences and mathematics, and in many other domains. During the last decade, argumentation has attracted growing attention as a linguistic, logical, dialogical, and psychological process that sustains or provokes reasoning and learning.

As a means of improving students' understanding in the classroom, argumentation can be called upon to trigger learning in many ways. Argumentative practices involve making explicit and public one's own stance and justifying it to another person or to oneself. Argumentation allows for explorative, critical and enquiring approaches to reality: encouraged to test the validity of each other's ideas, the learners are led to formulate objections and counter-objections and to understand a multiplicity of positions. Argumentative practices in science education are interesting because they invite pupils to use and come to understand rules of reasoning that are used in scientific work: pupils search for reasons, examine the available data, test alternative hypotheses, etc., which allows them to discover that science is more about trying to construct and resolve problems in specific theoretical frames than a matter of "discovering" things that might have been hidden since the beginning of the world. This is in contrast with students and laypersons' preconceptions. It implies that confrontation of perspectives is "fair-play" and that submitting to majority world views, prejudices, or status does not contribute to knowledge construction. Argumentative practices are powerful resources to deal with cognitive contradictions, doubts, controversies, complex decisions, etc. They invite participants to engage both in reasoning and in search of information. They require participants to coordinate their actions and reflections and to experiment with a reflexive position that enhances decentration

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capacities. Because learning does not solely mean acquisition of information or the appropriation of ready-made objects of knowledge, argumentation also entails the emergence of new understandings and the creative restructuring of previous ones: the learner is the co-author of a constructive socio-cognitive process in which argumentation holds important functions.

Argumentation is thus of interest to researchers and practitioners in education who are concerned with the social and cognitive processes that promote learning. However, learning argumentation and learning by arguing raises theoretical and methodological questions: How and when do learning processes develop in argumentation? Is it the case for all subjects? How does one design effective argumentative activities? How can the argumentative efforts of pupils be sustained? What are the psychological issues involved when arguing with others? How can what the learners produce be analyzed and evaluated? The argumentative activity requires specific intellectual and social skills and it is often emotional and demanding. Introducing argumentative activities in educational settings is not yet common. It requires attention at different levels. The complex argumentation skills must be given opportunities to develop in the growing child. At the interpersonal level, argumentation means confronting other people's perspectives. People often avoid these kinds of situations, which they tend to perceive as a risk to the self and to the relationship. At the institutional level, argumentative activities are sometimes considered time consuming when curricula are already overloaded. These activities require special social skills from the teachers, as well as ad hoc teacher training and assessment practices. At the cultural level, argumentation means the acceptance that social harmony is not threatened by the expression of a plurality of opinions; that assertions have to be backed up; that authority is not sufficient; and that discussions are permitted even when relationships are asymmetrical.

As a result of this complexity, it is not possible for teachers to just improvise argumentation based learning activities in the classroom. Precise design and adaptive management are needed. This book offers perspectives on these issues in an interdisciplinary effort to develop original theoretical and methodological perspectives using results from empirical research. The authors, active in the fields of theory of argumentation, psychology, and education, provide here elements to understand what happens when argumentation is introduced into the classroom. They share a common perspective on argumentation with special attention paid to communication and context. They also share a common understanding of education as oriented toward the enhancement of individual and collective agency in the development of knowledge, sociability and democratic social responsibility.

The book is organized into two main parts: theoretical foundations and research results are presented in the first part and an examination of existing innovative practices and lessons learned from them constitutes the second part.

The development of argumentation theories in the contemporary epistemological scene is central to the chapter "Argumentation as a social and cultural resource" by Eddo Rigotti and Sara Greco Morasso. They consider, in particular, the pragma-dialectical approach for its focus on the theoretical kernel of the discipline and for systematically eliciting, from this, the connected methodological implications.

The key notion of argument is specified by comparing it to the apparently near notion of demonstrative proof. Analogies and differences are brought to light, and the rather fuzzy but challenging and fundamental notion of *reasonableness* is identified as denoting the main value at stake in argumentative interactions. The authors propose a model of argumentative intervention in which argumentation is conceived as a particular type of communicative interaction. The model aims both at producing and at analyzing/evaluating argumentative interventions. The fundamental claim is that assuring the quality of argumentation implies contributing to a healthy social consensus and promoting cultural development at the individual and collective levels.

The chapter, "Psychosocial processes in argumentation," by Nathalie Muller Mirza, Anne-Nelly Perret-Clermont and colleagues, examines argumentation as a psychosocial practice embedded in institutional, historical and cultural contexts. Argumentation occurs when the conversation flow is disrupted by a disagreement, a question, or an alternative hypothesis. It is not easy to develop this peculiar communication, as it entails complex issues at the personal and interpersonal levels. Even though they are in reality interwoven, several dimensions are distinguished. At the cognitive and individual level, the questions include the following: what are the cognitive prerequisites for engaging in an argumentative interaction? How is the development of argumentative skills taking place in children? Beyond the individual level the authors take into consideration other dimensions that are important, such as the relational and dialogical aspects of argumentation, the status of the partners, and the characteristic of the "audience." The specific demands of the institutional and cultural context in which argumentation takes place are also examined. Developmental, social, and socio-cultural approaches in psychology are thus convened in order to construct a better understanding of this complex practice.

Baruch Schwarz's chapter provides multiple perspectives on the intricate relationship between argumentation and learning. Different approaches to learning impinge on the way argumentation is conceived: as a powerful vehicle for reaching shared understanding, as a set of skills pertaining to critical reasoning, or as a tool for social positioning. Each perspective has harvested empirical studies that have stressed the importance of argumentation in learning. In spite of the pluralistic stance adopted, this chapter attempts to draw connections between the findings obtained in the different perspectives. In a separate part, it considers the specific role of argumentation in the learning processes and outcomes for four subject areas: in mathematics, studies are presented that show deep gaps between argumentation and proof; in science, experimental studies are reviewed to examine whether and how argumentation promotes conceptual change; in history, the chapter considers the role of argumentation in challenging narratives and in claiming a position; and lastly, the chapter describes the new wave that characterizes civic education programs toward the instillation of argumentative practices in democratic citizenship.

Under the title "Argumentation and the social construction of knowledge," Michael Baker deals with two questions: firstly, what might students learn by engaging in argumentative interactions? And secondly, by what cognitive-interactive processes might they achieve this? An approach to understanding argumentative interactions, produced in problem-solving situations, is outlined and shows them

essentially as attempts to solve an interlocutionary problem, i.e., that of deciding which putative problem solutions to accept or not, by drawing on additional knowledge sources (termed "[counter] arguments") that potentially change the degrees of the acceptability of solutions. This process goes hand in hand with the exploration of a dialogical space and with the negotiation of the meaning of key notions underlying the debate. The analysis of an example of argumentative interaction, involving two adolescent students in a physics classroom, reveals this exploratory process, together with the essentially unstable nature of students' viewpoints, given that they are engaging in argumentation with respect to ideas that are still under co-construction.

Baruch Schwarz and Jerry Andriessen, in their common chapter "Argumentative design," discuss the educational architecture of argumentative activities. Productive argumentative activity may be encouraged, for example, by elicitation procedures, with argumentative scripts, by confronting subjects with hypothesis testing, and by pairing peers that have differences of opinion. What are the main results that research has delivered in such cases? A second section of the chapter is devoted to the designed use of collaborative technology for fostering and representing argumentation. Experiments using scenarios which feature a blend of technology and human interaction are discussed.

Beginning the second part of the book, Neil Mercer's chapter, "Developing argumentation: lessons learned in the primary school," argues three main points: first, that one of the most important aims of education ought to be to develop children's capability for argumentation; secondly, that teachers can make a significant contribution to this development; and thirdly, that the development of children's use of language as a tool for argumentation helps the development of their individual intellectual capabilities. To do so, Neil Mercer first discusses the importance of children's engagement in dialogue for the development of their thinking and understanding. He then considers education as a dialogic process in which both the talk between teachers and learners and the talk among learners have important roles to play. Finally, he describes some classroom-based research which has enabled teachers to encourage the development of children's use of spoken language for thinking and arguing effectively together, and which has also provided empirical support for the relationship among thought, language, and social activity, as claimed by the Russian psychologist Lev Vygotsky.

The practice oriented contribution, "Argumentation in higher education," by Jerry Andriessen presents one case of using interactive media for supporting collaborative argumentation by university students. The discussion is descriptive, focusing on the scenario and the tools that are used and on examples of actual discussions by students. Some basic mechanisms of employing argumentation are illustrated by students using computer tools (chat, forums, graphical tools) for producing an argumentative essay. This chapter shows some of the characteristic constraints that are involved in implementing argumentative learning in university practice.

How can argumentation skills be improved by engaging students in argumentative practices where they are helped to assume a healthy critical attitude and provide reasons for their positions? What are the synergies of learning to argue and arguing to learn? "The Argumentum experience" by Sara Greco Morasso, originates from

these questions and relies on the experience of teaching argumentation at university level in the framework of the Swiss Virtual Campus project Argumentum (http://www.argumentum.ch). After presenting the aim and structure of Argumentum, this study focuses on a specific experience of argument production and analysis that occurred in the pedagogical scenario of argumentation classes at the master's level. Finally, the chapter elaborates on the lessons learned from this experience.

By drawing upon existing theoretical and empirical resources to discuss the successes and difficulties encountered in trying to introduce or sustain argumentative activities in learning settings, the authors of this book hope to contribute to the promotion of a large program of research. In their opinions, considering argumentation as a key activity at the heart of many developmental processes, in individuals and in society, opens the way to a deeper reconsideration of teacher training, curricula, and also of the nature of human knowledge and its potential advancements.

Part I
Theoretical Foundations

Argumentation as an Object of Interest and as a Social and Cultural Resource[1]

Eddo Rigotti and Sara Greco Morasso

Abstract The development of argumentation theories in the contemporary epistemological space is shortly outlined and the pragma-dialectical approach is, in particular, considered for its focus on the theoretical kernel of the discipline and for systematically eliciting, from this, the connected methodological implications. The key notion of *argument* is specified by comparing it to the apparently near notion of *demonstrative proof*. Analogies (discursiveness, inferentiality, procedurality, critical approach) and differences (things that could also be in a different way, pragmaticity, use of ordinary language, implicitness) are brought to light, and the rather fuzzy but challenging and fundamental notion of *reasonableness* is identified as denoting the main value at stake in argumentative interactions. The authors propose a model of argumentative intervention in which argumentation is conceived as a particular type of communicative interaction. The model aims both at producing and at analyzing/evaluating argumentative interventions. Three core aspects of the argumentative intervention are highlighted in the model: the social *context* of communicative interaction, both in its institutionalized and in its interpersonal components, which is seen as the environment of argumentative activities; the *inferential structure* of argumentation, in its dialectical and relational components; and the *quality* of argumentation (distinguishing sound and manipulative argumentative moves). The fundamental claim is that assuring the quality of argumentation implies contributing to a healthy social consensus and promoting cultural development, at the individual and collective levels.

Keywords Argumentation, Reasonableness, Argumentation studies, Argument schemes, Loci, Argumentum Model of Topics, Manipulative processess

[1] We are indebted to Joëlle Stoudmann for the very accurate and competent language revision.

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1 Argument: In Search for the Hidden Meaning of the Word

The Latin word *argumentum* covers a fundamental notion of Argumentation theory. This word, which is immediately recalled by equivalent terms in many modern languages (English *argument*, Italian *argomento*, French *argument*, German *Argument*, Russian *argument*), is a noun derived from the verb *arguo*. We find in its lexical structure the key to its semantic content; thus, analyzing the way it is built constitutes a significant help to approaching our subject. The word is formed by the verb *arguo* and by the suffix – *mentum*. Now, the Latin suffix – *mentum*, bound to a verb, refers, in general, to the process of realisation of the action which the verb represents, indicating, in particular, the way and the means or instruments with which the action is realized. One should think of examples such as *documentum* (a device used to inform), *monumentum* (a device used to remember), *adiumentum* (a device used to help), *alimentum* (a means used to nourish). In the same way, the word *argumentum* can be understood as "a device to *arguere.*"

The Latin verb *arguo* has entered numerous modern languages (English *to argue*, Italian. *arguire*, French *arguer*), changing its values perceptively. Nevertheless, it has kept one fundamental meaning, that of *pointing out*, of *bringing to acknowledge* and, therefore, also of *proving*. In other words, it basically seems to indicate the process of "helping" the interlocutor recognize something by (directly or indirectly) giving him the necessary justification. In this respect, we have a particularly interesting case, when the meaning of "showing something" is used as "demonstrating the guilt of" or simply *accusing*. In this case, the focus is on an aggressive and polemic implication, which is not infrequent in argumentation: thus the Latin words *argumentor* and *argumentatio* incorporate the value of discussing, debating polemically. This meaning is entirely expressed by the English verb *to argue*, which is often used in the sense of "*discussing heatedly*" and even as synonym of *to quarrel*.

In the noun *argumentum* anyway, the fundamental value of *reason*, *evidence* and *proof* prevails, although other values are not completely absent.[2]

The fundamental value of *arguere*, as "to bring to recognize" the reasonableness (i.e. the grounds) of a standpoint, was already established in the ancient rhetoric. Cicero's definition of *argument* is the following (Cic. Top. 2, 7, see Reinhardt 2003):

ARGUMENTUM EST **RATIO**, QUAE **REI DUBIAE** FACIT **FIDEM**

Here the argument is seen as a procedure demonstrating the credibility of an uncertain statement which needs to be proved. Therefore, the argument rests on something that is already established in order to demonstrate the truth of a still uncertain hypothesis (Quint. 5, 10, 11, see Winterbottom 1970).

ARGUMENTUM EST RATIO **PROBATIONEM** PRAESTANS, QUĀ COLLIGITUR ALIQUID PER ALIUD, ET QUAE, QUOD EST DUBIUM, PER ID QUOD DUBIUM NON EST, **CONFIRMAT**.

[2] Since the argument is considered to be the central and substantial element of the discourse, the element on which the whole discourse is based, in the case of narrative texts, "argument" is used to indicate the story, understood as the kernel of a narrative text.

2 Argumentation and Reason

The word *ratio* appears in both definitions. It is incorporated in many modern cultures in derived terms (*reason*, *ragione*, *raison*). This word carries a complex content, which should be further discussed, also from a philosophical point of view. The term *ratio*, as well as the other derived terms in modern European languages, presents a variety of meanings. Reason, understood in many traditions as distinctive human faculty, could be defined, in general, as the instrument or organ which enables us to establish a relation to reality. In this relation, there is a strong relationship between reason and language. Both concepts are embraced and kept together by the Greek term *logos*.[3] Other values emerge in the vast polysemy of this term, e.g. the value of *calculus*, also implied by the Latin *ratio*.[4] Another usual value is that of connection or rapport, in mathematical sense; Cicero's definition of argument would become, in this interpretation, particularly perspicuous: an argument is a connection enduing reliability to a questionable thesis.

Within modern argumentation theory, the English word *reason* definitely is a keyword, not only because of its fundamental value as mentioned above, but also in the sense of *"the reason why,"* and is understood as a justification (why something we believe should be claimed) rather than as a cause (why something happens). Here reason is understood as the legitimating basis supporting a standpoint. In other words, reason coincides with why one believes it to be worth supporting a certain opinion (judgement, evaluation, etc.). From the primary value of the term *argument*, it emerges that to argue is a form of discursive move in which we do not limit ourselves to expressing or communicating ideas, opinions, proposals, wishes, projects, etc., but we want to justify them, prove them by reasoning. Thus, in argumentation, we commit ourselves to maintaining a critical attitude in front of ourselves and the others.

Obviously, one cannot expect to prove or to discuss everything. It is unreasonable to ask for proof of or to question evidence. Thus, it would be unreasonable if someone who was in Berne yesterday answered to a question like: "What was the weather like yesterday in Berne?" with such an answer: "The weather forecast said it would be cloudy in Berne." Instead, if the question were: "What will the weather be like tomorrow in Berne?", it would be reasonable to report the weather forecast, as the future can never be considered a fact; and it would be reasonable to answer in an argumentative way, referring to the "authority" of the weather forecast on TV. Thus, there are statements that are based directly on our experience and others that are based on reasoning. Furthermore, one should consider that there is an essential link between the moment of arguing and the reference to evidence: by using argumentation, we try to trace an uncertain discourse, which per se does not have a basis, back to another discourse. At this point, this discourse can be either based

[3] For an explanation of the role of *lógos* in communication, see Rigotti and Cigada (2004), in particular chapter IV. In his moral tractate *De officiis,* I, 50 Cicero proposes a nice hendiadys (*ratio et oratio*, "reason and discourse") for rendering in Latin the complexity of the Greek word (see Winterbottom 1994).

[4] The Latin language indicated a bookkeeper by using the expression *a rationibus* (in charge of accounts).

directly on evidence or justified by argumentation. This argumentation could be based on further argumentation. However one cannot endlessly continue with this chain of argumentation: our discourse, sooner or later, has to link with evidence. However, even if we are not always aware of it, our knowledge and our decisions are often based on a large amount of inferences: elaborating a judgment, evaluating advantages and disadvantages of alternative actions, deliberating about something (as in the case of politicians having to establish which languages must be studied by pupils in primary education), but also evaluating the dynamics of an event that occurred many centuries ago (as historians must do), and many other situations, require that we apply inference on the basis of some evident data.

A correct reasoning and a faithful adherence to evidence represent the two fundamental components of critical commitment. And critical commitment is essential for the good quality of endless intellectual operations and practices that involve arguing in its individual and collective use, such as understanding the meaning of a message, explaining a natural fact or a human behaviour, clarifying a doubt, making decisions, taking position in a controversy or debate, settling a conflict, deliberating about something, counselling, increasing knowledge,[5] establishing an opinion, persuading oneself or others, etc.

The way we have defined argumentation seems to hold both for argumentation and for mathematical proof. In fact, in both argumentation and proof, one passes from the truth value of one proposition to the truth value of another proposition, namely one determines the truth value of a proposition which is unknown, starting from the truth value of another proposition which has already been established. Since antiquity the fact that an argument is a type of proof has been observed.[6] Nevertheless, we must not neglect the fact that, beyond the important similarities in the applied procedures, significant differences can be found. In the following, the analogies and differences between these two concepts (see Fig. 1) will be highlighted.

3 Argumentation and Proof: Analogies

A first aspect that argumentation and proof share is ***discursiveness***: they form a *discourse*, namely a text (oral or written) which is necessarily articulated in more than one communicative move. This is especially evident for mathematical proofs: there is no proof that is not articulated in a hypothesis, a thesis, and in a proper

[5] In this volume, Baker shows the relevance of argumentative interaction in the process of social construction of knowledge. In particular, the paper explores the resolution of the so-called "interlocutionary problems," i.e. of "problems that are embedded in social practices […] that may be both formulated and solved in language exchanged in interaction." Andriessen, in this volume, describes an educational activity designed for enhancing university students' understanding of scientific texts, through the use of graphical tools aimed at supporting argumentation. By discussing the strengths and weaknesses of such an activity, Andriessen shows the importance of a well-thought argumentative design.

[6] In the first lines of Aristotle's Rhetoric, *pistis*, as trustworthiness, created in the process of argumentation, is defined as a sort of proof.

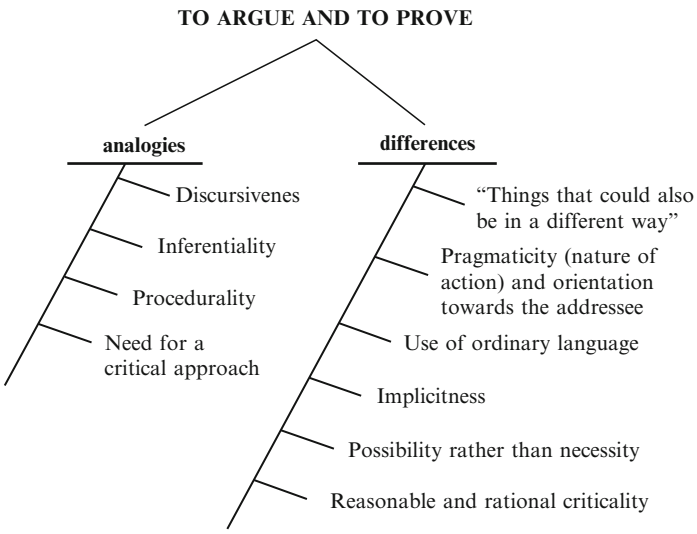

Fig. 1 Representation of analogies and differences between argumentation and proof

proof. As for argumentation, the model of Stephen Toulmin (1958)[7] highlights the property of discursiveness, structuring the argumentative strategy in a series of discursive moves, conceived as answers to the critical questions of a potential interlocutor. Thus, the arguer must first of all base his standpoint (*claim*) on a foundation (*warrant*) that justifies it. Furthermore, he must base the relationship between foundation and thesis on a law or general rule (*backing*) according to a sequence of moves that form the discourse. The model elaborated by Toulmin can be presented in a diagram (see Fig. 2), which is illustrated below, by means of an example:

> Giuseppe must be renting his beautiful apartment, because he does not earn enough to own it, and one needs a very high income in order to afford a luxurious apartment that is very expensive. Unless… he has inherited something or won the lottery.

A model like Toulmin's, which underlines the dimension of the discursiveness, seems to be contradicted by many single communicative moves, which nevertheless have an argumentative nature. For example:

– MARIA: Are we going out?
– LUIGI: It's raining cats and dogs.

Luigi's answer, in this brief dialogue, seems to be accomplished in one single linguistic act; indeed, it hides an articulated discourse, which can be made explicit and which can be represented in Fig. 3.

Luigi expresses only the circumstance (*Datum*) that justifies his decision not to agree with the proposal to go out. This circumstance is part of a chain of reasoning which has brought him to this conclusion. The conclusion (*Claim*), the *Warrant*, the

[7] Toulmin's model was presented in the book "The uses of argument," published in 1958.

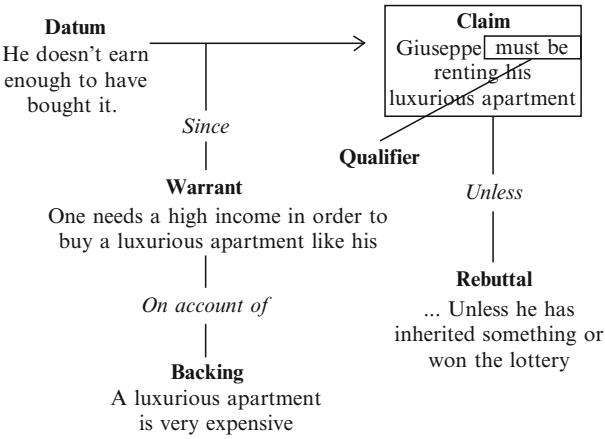

Fig. 2 An application of the model of Stephen Toulmin (1958)

Backing as well as the other steps of this reasoning remain implicit here. At this point, we can say that in argumentation the omnipresent feature of discursiveness can be latent, i.e. implicit. On the opposite, in the case of mathematical proof we have one or more *hypotheses* (corresponding to the *Datum* in Toulmin), a *thesis* (corresponding to the *Claim* in Toulmin) and finally a *demonstrative process* (which corresponds to Toulmin's *Backing* and *Warrant*). This brings us from the hypothesis to the thesis, thanks to a precise number of steps which are explicitly formulated and justified. In mathematical proofs, the articulation of the subsequent steps is always manifest because proofs try "to approach the ideal of communicating the relevant inferential path in an entirely explicit way – although these texts do adopt procedures of synthetic quotation for referring to axioms and conclusions of former proofs, as these procedures are explicitly declared, the principle of explicitness is observed" (Rocci 2006).

Both argumentative discourses and proofs have an *inferential* nature, as they derive the value of truth of a proposition from the value of truth of another proposition. This obviously leads to a connection between the truth-values of the two propositions, namely the truth-value of the one depends on the truth-value of the other. If someone affirmed that Dante Alighieri wrote the *Divine Commedy* in 1340, we could object that this is not possible, as Dante died in 1321; and it is not possible for a person to be at the same time dead and writing, or performing any other activity. It is surprising how decisive inference appears to be, not only in the development of the human knowledge, but also in communal life and in everyday communication. At the level of knowledge, even if the number of statements obtained, thanks to the observation of experience – namely of *data* – is infinite, one can establish a lot more indirectly, by *inferring* knowledge from other knowledge. It often occurs that the same information is a fact of experience for one person, while for many others

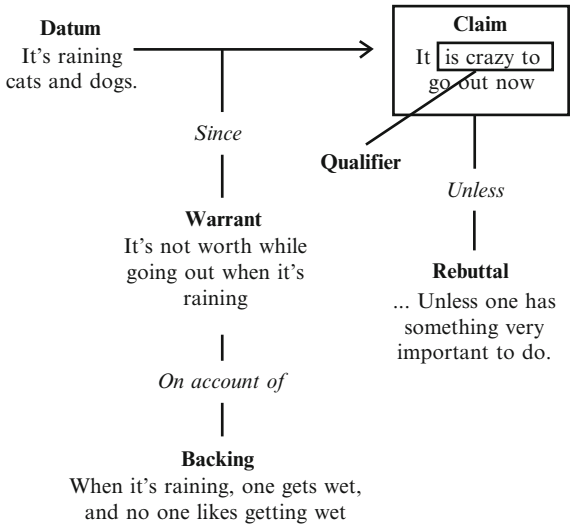

Fig. 3 Application of Toulmin's model (second example)

it is obtained by inference. The whole scientific activity is based on a balance of observation and inference (Schwarz in chapter "Argumentation and Learning" of this volume).

Inference plays an extremely important role both in the cognitive and in the communicative dimensions. Concerning information derived from empirical data, as soon as they have passed from the direct witness to an addressee, they do not represent for the latter experienced data: the addressee can believe this information if he values the information source. Even this kind of information, thus, derives from a particular case of inference: "All the information coming from x is true, p is information coming from x, therefore, p is true." This is based on the well-known *argumentum ex auctoritate* (*argument from authority*), an argumentative procedure which, although it is very often employed, turns out to be rather risky in many of its applications.

The role of inference in communication is twofold. On the one hand, it intervenes in the constitution of many messages which are partially or totally argumentations or proofs. On the other hand, inference intervenes in the communicative process as well. Actually, we have already seen that in argumentation, many moves or passages remain implicit, thus they do not directly become manifest but are left to be deduced – almost to be guessed – from other information that is often incomplete. This is true not only for argumentation, but generally for any communication (verbal and non-verbal). The process through which the receiver reconstructs the sense of a message, starting from a discourse which is usually full of gaps, is an inferential process. The message is integrated according to the *Principle of charity* (or *Principle of good will*), i.e. postulating implicit discursive structures which

allow the reconstruction of a globally acceptable sense and which respect the semantic congruity, the logical coherence, the pragmatic congruity and the dialogical rules. The term *communicative inference* defines the inferential processes used by the receiver in communication in order to integrate the message. The term *communicated inference* defines the proper argumentative and demonstrative processes that are conveyed as part of the messages.[8]

In order to see the relevant role that is played in argumentation and proof by the underlying (abstract) ***procedural*** structure, it is of use to identify such a structure in apparently different inferences.

Let us consider the following examples:

A: Where there is no water, there is no life.	A: Canines are carnivorous	A: When at night the sky is cloudy, there are no stars
B: There is no water on Mars.	B: The fox is a canine.	B: Tonight the sky is cloudy.
C: Therefore, there is no life on Mars.	C: The fox is carnivorous.	C: Tonight there are no stars.

It is rather evident that these three examples of reasoning do not derive their strength from the fact that one fragment of reality is considered instead of another, but from a procedure that, being essentially identical, is instantiated by our examples in different domains. We could informally describe this procedure in the following manner:

If, for every x for which P holds, Q also holds,
and there is an x for which P holds,
for this x, Q also holds

The inferential strength of these inferences does not depend on the fact that x are places (*where*), times (*when*) or living beings (*foxes*) and that P and Q are implemented by different aspects, but on the logical form of the propositions. In other words, the strength of the inferential procedure is not bound to the actual states of affairs whereof the situation consists, but rather to the structure of those states of affairs and to the relationships between them.

In this relation, it is important to distinguish inferential validity and truth. The three examples of inference that were illustrated above are all formally valid. Let us return to the first example: if it is true that there is no life where there is no water (and it seems reasonably true to assume this), and it is also true that on Mars there is no water (although there seems to be contrary evidence to this fact), it is certainly true that on Mars there is no life, given that the inferential procedure was realized in an exemplary way, namely the truth of C is proved if A and B are true. In our example,

[8] For a more detailed account of the notions of *communicative inference* and *communicated inference*, see Rocci (2006), in particular pp. 418–424.

the truth of A and B does not seem to be given and therefore I cannot concede the truth of C. But the inferential procedure is correct (valid), even if it cannot demonstrate the truth of the conclusion, given that one of the premises is false.

At this point, it is clear that in order to have a good reasoning, a valid inference is not enough. The premises from which the reasoning moves should be anchored to incontestable evidences.

For the argumentation to be correct it is also essential to verify the *semantic coherence* of the terms used in reasoning. As Aristotle pointed out, it is important that the same term is not used with different meanings in the same reasoning, in order not to be misleading[9]; thus, it is necessary to undertake a semantic analysis of the terms in order to verify the correctness of the argumentation.[10] Such analysis must sometimes be rather sophisticated because the polysemy is hidden by the structure of language. Let us consider the following example:

(A) Rare things are expensive
(B) Houses at a good price are rare
(C) Houses at a good price are expensive

Conclusion C is overtly contradictory in itself. Therefore, someone might be tempted to use a similar procedure to say that "argumentation is not important" when talking about serious aspects of life, like economics; thus, argumentation would be discredited (but, from another point of view, even economics could be discredited). An improper use of argumentation is surely possible, but this must not induce us to think that argumentation is irrelevant. It would be as if someone, noticing that having wrong nutritional habits is unhealthy, stopped eating… In the reasoning

[9] It is worth quoting here the whole passage by Aristotle (Topica I, see Ross 1958): "It is useful to have examined the number of meanings of a term both for clearness' sake (for a man is more likely to know what it is he asserts, if it has been made clear to him how many meanings it may have), and also with a view to ensuring that our reasoning shall be in accordance with the actual facts and not addressed merely to the term used. For as long as it is not clear in how many senses a term is used, it is possible that the answerer and the questioner are not directing their minds upon the same thing: whereas when once it has been made clear how many meanings there are, and also upon which of them the former directs his mind when he makes his assertion, the questioner would then look ridiculous if he failed to address his argument to this."

[10] During the Middle Ages an example was suggested, which underlines the difficulties that can emerge from the semantic ambiguity of the terms used in argumentation: "A: Quidquid *currit* habet pedes; B: Sequana *currit*; C: Ergo, Sequana habet pedes." A functional translation of this example into English could be: "A: Everything that *runs* has legs; B: The engine *runs*; C: The engine has legs." But there are also more 'updated' examples, like the following: "A: In order to *read* one needs eyes; B: My computer *has read* the file you sent me; C: My computer has eyes." Of course, these examples may appear quite trivial, and being misled by them seems unlikely. However, we might think of cases in which semantic ambiguity has really caused misunderstandings in various contexts. For instance, the democratic system of Switzerland nowadays has a structure very different from the one that the Deutsche *Demokratische* Republik (DDR) had until 1989… And, nonetheless, both systems claim or claimed to be *democratic*.

mentioned before, the ambiguity is linked to the use of the verb *to be*, which incorporates two different meanings in A and B. In order to eliminate the ambiguity, the premises could be paraphrased as follows:

(A) When the number of objects being sold is smaller than the number of objects being looked for, these objects *tend to cost a lot* (because the seller generally wants to earn as much as possible from the sale and therefore favours the buyer that will pay more…)
(B) The number of houses that are for sale at a good price is smaller than the number of houses being looked for.

Therefore, in B, *to be* indicates the ascertainment of a fact; in A instead, *to be* indicates a law of tendency ("they *tend to be* expensive"). Indeed, here are also objects for sale that are less numerous than the persons wanting to buy them, and which are not expensive (because they are not known to all the possible buyers, because buyers have very personal wishes, because many people want to sell quickly because they need the money immediately, because not all sellers are moved exclusively by the principle of profit).

From two premises of this kind we cannot derive any conclusion stricto sensu, unless this conclusion is very vague and has a reduced logical claim, like the following: "Houses at a good price tend to become expensive if they are demanded by many people." At this point our procedure would become correct, and even gain reasonableness:

(A) When the number of objects being sold is smaller than the number of objects being looked for, these objects *tend to* cost a lot (because generally the seller wants to earn as much as possible from the sale and therefore favours the buyer that will pay more…)
(B) The number of houses that are for sale at a good price is smaller than the number of such houses being looked for.
(C) Houses for sale at good prices *tend to* become expensive when the potential buyers come to know of the offer.

At times, being critical is understood as enjoying the fact of questioning everything, of finding moot points in standpoints (especially someone else's). The image of *criticism*, in the sense of criticizing, refers to polemic and to a reasoning activity which is aimed at discrediting the interlocutor. Thus a critical attitude is often associated to a polemical character. Instead, *the need for a critical approach* in argumentation and proof arises mostly from the need to find adequate reasons for one's actions, decisions, convictions, theories… The two pillars of critical commitment in all its manifestations are *adherence to evidence* and *correct reasoning.* They constitute the two fundamental aspects of reason's commitment to adhere to reality in its various aspects: one can be more or less critical in scientific research, in everyday life, in making individual or collective decisions, or in the evaluation of ethics or aesthetics.

A direct implication of the adherence to evidence is the application of the correct method when approaching the object. If I want to calculate the distance from the Earth to the Moon, I will use a certain kind of data, certain instruments and a certain

kind of reasoning as well as computational procedures. However, if I want to decide how to arrange the furniture in my living room, I will take other aspects into account (such as my personal taste and the criterion of comfort, which were not relevant in the first example), and use different instruments (I will use the rule instead of the telescope). In short, the method to tackle a problem critically depends on the nature of the problem itself: therefore, criticality is defined as the application of a method which is adequate to the object being considered. Thus, also in scientific disciplines, different methods correspond to different objects of investigation: scientific research in history is not less critical than scientific research in mathematics or geometry, even if they are very different (Schwarz, chapter "Argumentation and Learning" of this volume). Furthermore, a critical commitment is also requested for the management of interpersonal relationships, for the construction of social consensus, etc. In all these domains, the actualisation of the concept of critical commitment depends on the object one has to deal with.

4 Argumentation and Proof: Differences

Beyond the numerous traits and characteristics that argumentation and proof have in common, and which we have briefly described in the preceding paragraphs, it is important to focus on the specific traits of each of these reasoning procedures, in order to identify the specific traits of argumentation.

Argumentation and proof tend to apply to different spheres. Proof *does not* intervene, in general, when we are dealing with facts that are in a certain manner but could also be in another[11] (the fact that the house belongs to x and not to y, the fact that a certain person is married or not, the fact that a country is at war with another or quietly in peace, the fact that a judge convicts or absolves someone, etc.). Rather, it intervenes when we need to establish the structure of reality (constant acceleration when in free fall, the relationship between angles in triangles, the speed of light, the speed of sound…). Argumentation is reason applied to life in its actual communal or private dimension: in most cases, it does not concern knowledge but action, which does not operate in the sphere of general principles and solid structures but in *the field of things that are in a certain manner but could also be in another* and that can be changed, made, or destroyed by human intervention. I cannot change the timetable of the sun, but I can produce artificial light; I cannot change the seasons, but I can produce cold and heat; I can build houses, set up informative systems, I can harm or help others, favour or damage the natural balance, support a healthy or a perverse consensus, settle a conflict or provoke it…

Thus the proper scope of argumentation is the area of *communal life and of human action*. Argumentation itself actually is an action or, to be more precise, an interaction of communicative nature (Rigotti 2003). As such, argumentation is

[11] Aristotle speaks, in this connection, of "things that could also be in a different way" (see Ross 1959).

generated from a strategy of intervention aimed at changing the social context, in other words directed at influencing the addressee's opinions and behaviours. Argumentation does not limit itself to increasing the cognitive world, but becomes an intervention that involves the human interaction in a more comprehensive manner. Argumentation can be considered as a special kind of communicative *exchange*, where reasons are provided in change of the agreement of a *decision maker*. In fact, the nature of interaction of the argumentative intervention, which is aimed at affecting also the arguers' pragmatic and social spheres, implies that the discourse is intrinsically oriented towards an addressee, which is more properly a decision maker (gr. *krités*[12]). However, we cannot speak of an influence *tout court*: when the reasonableness of an opinion is demonstrated, the addressee is invited to make a free decision and to adhere to the other's opinion if he believes in its reasonableness. The process of proof – in its classical use in the scientific discourse – aims at an essentially cognitive goal: I do not demonstrate a theorem or a physical law primarily in order to convince somebody, but in order to develop an objectively scientific discourse, i.e. a discourse whose justification lies within the discourse itself. Argumentation, however, is used and realised in order to found an opinion for someone, namely in order to persuade someone of the validity of an opinion. I prepare an argumentation when I need to persuade someone to decide in a certain way on something that concerns me. This holds, somehow, also in that apparently soliloquial argumentation that takes place in inner deliberation (Perelman and Olbrechts-Tyteca 1958), where the single subject alternates the roles of protagonist and antagonist. Muller Mirza et al., in this volume, present the interactive and dialogical dimension of argumentation as an essential feature of this activity, which essentially involves the relationship between two (or more) human beings.[13] As shown by Schwarz in chapter "Argumentation and Learning" of this volume, even scientific proofs, when they are presented in the didactical context, need to be "transformed" into argumentative processes that take into account the learners' position and their personal path towards understanding and persuasion.

The decision maker is always present in the conception of an argumentative discourse; argumentation does not only have the task to ascertain the truth, as in proof, but also to show and display the truth of a standpoint to an interlocutor, who can then decide to consider it or not, while making his decision. One always argues *for someone*, namely for a decision maker who can be a single person, a group of persons or even the arguer himself when thinking something over before making a decision. The addressee of the argumentation is therefore not an external listener to the discourse, but a true stakeholder, who has interests in the argumentation as it is up to him to decide: the decision maker is the voter who has to vote for this or that candidate, the student who has to choose this or that university, a person living in a

[12] The term *krités* (eng. *decision maker*) derives from the Greek verb *kríno*, which literally means "sieving." The *krités* is the person that sieves a discourse, extracting the truth it contains, and evaluating it in order to make a decision.

[13] By this, we do not want to underestimate the importance and the specificity of individual reasoning, which should in any case be distinguished from proper argumentation. This latter involves the subject's public assumption of a standpoint and, thus, of a commitment in front of an audience.

big city who has to decide whether to take the subway or the car, etc. but also the bank that has to decide whether to concede a loan, the editorial staff of a newspaper who has to decide which news to put on the front page.

Proof is entirely conceived in the language of the discipline of which it is part (technical terms, charts, symbols, formulas…). In an argumentation, *ordinary language largely prevails*, even if it can present technical terms – for example, from the legal, financial, economic areas, etc. – when used in specialised contexts. Yet, the argumentative procedures are managed by words of the ordinary language; these words are often imprecise but familiar and basically understandable to everyone. In other words, argumentation is logically structured (as we will see in the continuation of this chapter), but it becomes manifest through ordinary language. If this, on the one hand, allows the use of argumentation in the construction of society, in the generation of consensus, in the pacific management of conflicts, etc., it is on the other hand true that the use of ordinary language may cause imprecision, ambiguity and therefore also misunderstandings.

Considering the trait of discursiveness, we have seen that its explicitness can be absent in argumentation, while it is essential for proof. In fact, proof has the task to highlight and to show the inferential procedure in all its steps. *Argumentation is largely implicit*. It is interesting to observe that in argumentation, instead, the degree of explicitness of the inferential procedure depends on a communicative principle which specifies the Gricean *maxim of quantity* (Grice 1975) for argumentation: it is essential to display only as much as one holds necessary in order to assure the comprehension of the procedure for a particular interlocutor. To say more than what is necessary is immediately understood either as unreasonable behaviour (doing something without reason) or as a lack of esteem for the addressee, who is thus considered to ignore the well-known facts or not to know how to reason properly (Tardini 2006, pp. 88–89).

Let us consider the following example. Sabrina is certain that Frédéric loves his home town, Basle, very much, and she wants to convince Walter of this. Sabrina cannot construct a logical proof that can unquestionably lead to the conclusion that Frédéric loves Basle; there are no theorems that demonstrate Frédéric's love for this town. Sabrina will therefore probably construct an argumentation to support her opinion:

> *Frédéric never leaves Basle, not even for the summer holidays!*
> *He always talks about his town in a very enthusiastic way, he collaborates with the local newspaper, and last year he even ran for the city council.*

Sabrina's standpoint is based on a reasoning in which, moving from the implications to the cause, feelings are interpreted as being the causes of behaviours, which are conceived of as the implications or signs of the feelings. Thus, constant presence, frequent proud discourses about and cultural and institutional engagement are presented as signs of Frédéric's attachment to Basle.

The reasoning in itself sounds exemplary; however, it is not a proof. In fact the evidences that are mentioned (witnessed) by Sabrina could be questioned, but, more importantly, the inference moving from the implications to the cause is far from ensuring incontestable truths, even though it can be adequate for providing reasonable hypotheses. Indeed, ascertained that a feeling of attachment "produces"