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ARGUMENTATIVE INTERACTIONS AND THE SOCIAL CONSTRUCTION OF KNOWLEDGE

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Introduction

Life is full of problems that we cannot solve alone, either because we do not have the necessary abilities or because the problems necessarily concern others. An example of the first case would be my sending an SMS message on a portable telephone (I do not know how to do that without help, although I could possibly find out), and of the second, deciding on the acceptability of human cloning (this is a debate that should concern everyone, not just oneself). In both cases, one way of trying to solve a problem is to engage in dialogue with other people in order to coordinate ideas and efforts. But whilst proverbial wisdom says that "many hands make light work", it also proposes the opposite, that "too many cooks spoil the broth". In other words, solving practical problems with others can create another kind of problem — that I shall term *interlocutionary*, since it is concerned with relations between locutions, or utterances — due to the fact that there can be a diversity of proposals for solving the practical problem, not all of which can usually be accepted at the same time. Thus, an interlocutionary problem requires deciding, together, which solution, or combination of solutions, to accept to a practical problem. In fact, I shall now call such "practical" problems *praxeological* problems (Meyer, 1982; Quignard, 2000), they concern not only physical actions (such as those involved in mending a car) but more generally, problems that are embedded in social practices (such as deciding what energy policy to adopt, or even solving mathematics problems at school), that may be both formulated and solved in language exchanged in interaction.

So, how are interlocutionary problems solved? The following are three possibilities amongst many (excluding physical violence or appeal to absolute authority). Firstly, people could try to ignore the problem: perhaps one person does not want to offend the other by appearing 'difficult'; perhaps there is a general feeling that the question is not sufficiently important to merit deeper discussion; perhaps they are short of time and want to move on, and so on. Secondly, people could restrict themselves to a simple exchange of divergent opinions: "yes that's right / no it isn't/yes it is/…". But such an approach does not generally produce the required result. Finally, each could express additional information and reasoning relating to the problem, of the kind that would

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potentially change the degrees of acceptability of the divergent solutions, and also examine the coherence of the sets of information and lines of reasoning expressed. I shall call this "argumentation in interaction", or more simply, "argumentative interaction".

In school settings, children are sometimes presented with praxeological problems, the attempted solution of which, in groupwork situations, may give rise to interlocutionary problems. And children are also sometimes presented with interlocutionary problems themselves (i.e. societal or other questions to be debated). In these cases, as mentioned above, schoolchildren may engage in argumentative interaction in order to try to solve the interlocutionary problem. However, the point of asking students to solve these various types of problems is not just that they should find solutions to them, but also that they should *learn* something by so doing, or, in other terms, that they should *construct new knowledge*. For example, in trying to build a model bridge together, students could construct new knowledge of forces operating on materials; in discussing human cloning they could gain better understanding of human biology. When knowledge is thus constructed in verbal interaction between students, the process by which this is achieved has been termed the *social construction of knowledge* (Perret-Clermont, 1979/2000).

This chapter is about the role of argumentative interaction in the social construction of knowledge. Intuitively, argumentative interaction should be important in this context since it involves extra thinking, the need to 'dig deeper' into the question being addressed. The aim here is to explore precisely the processes by which argumentative interactions could favour the social construction of knowledge, and the nature of the new knowledge in this case.

In the next section, two complex foundational notions will be discussed: the "social construction of knowledge" and "argumentation. This will be followed by a general critical examination of what types of knowledge could be socially constructed in and by argumentative interaction, and how. The chapter closes with a general analysis of an example of an argumentative interaction between two students (in a physics classroom), that illustrates some but (necessarily) not all of the points made previously.

Some theoretical considerations

The social construction of knowledge

The expression "social construction of knowledge" is quite frequently used in recent research on learning, in psychology and educational sciences. However, it can be understood in a number of different ways, depending on the theoretical perspective adopted.

From the standpoint of cognitive psychology, centred on the individual, referring to the "social" construction of knowledge simply means that *more than one person* is involved in that construction, possibly in an interactive situation, whose result — knowledge — is nevertheless seen as a property of the individual. Secondly, the "social" dimension of an interaction between students can be understood as that which is *not "cognitive",* that is, not centred on the problem-solving task itself (e.g. relational problems, expression of emotion, interaction coordination, etc.). Thirdly, the term "social" can refer to the fact that the interaction takes place between *social actors* (rather than machines, for example), who have specific statuses, roles, origins, and so on. Finally, a number of theoretical approaches, such as "situated learning" (Lave, 1988), see *knowledge as intrinsically a property and an emergent dimension of social groups*, or communities of practice. To the obvious rejoinder that people are quite able

to learn from solitary reading of books, it could be replied — from a Vygotskian perspective (Vygotsky, 1978, 1986) — that books themselves are social products, involving language, which is itself a social and historical product, that the individual human is nevertheless a social being, and that reading and thinking can be seen as species of operations with signs, of (internal) dialogue.

My own position with respect to these visions of the social and the cognitive depends firstly on distinguishing the two dichotomies "individual/group" and "cognitive/social": both individuals and groups can have both cognitive and social dimensions. On the one hand, it is not meaningful to sharply distinguish the cognitive and social dimensions of collective activity (Perret-Clermont, Perret & Bell, 1991), moreover, given that the fundamental 'building brick' of communication, the speech-act, encapsulates the cognitive and the social (Trognon, 1999). On the other hand, interactive learning, seen as fundamentally a social-and-cognitive process, needs to be studied in a way that nevertheless takes into account the articulation between processes happening within the group and at the individual level. This can be seen as a process of "internalisation" (Vygotsky, op. cit.), or rather, of becoming "autonomous" in carrying out a task. In other terms, the problem is to relate learning that takes place within the timescale of dialogue itself with longer-term learning in the individual (Trognon, 1993). In order to understand the problematic nature of comparing what happens in dialogue with what happens after it, possibly on the individual level, we need to discuss what the term "construction" could mean here.

It is a fundamental tenet of an "interactionist" approach to verbal interaction, that meaning is negotiated, constructed collaboratively, in the exchange (e.g. Kerbrat-Orrechioni, 1990). If an interaction has genuinely occurred, this means that what is thought and said is subject to mutual influence: it will not be possible to identify the 'individual thought' (at least, on the basis of analysis of an interaction corpus). How could one, therefore, genuinely compare what an individual thought in a dialogue with what that individual thought after it? In the context of verbal interactions, "social construction" should be thought of — as a first pass — as "*co*-construction" (of knowledge), or a construction in which several interlocutors have participated. It seems that a coherent approach would be to compare like with like, i.e. to compare what is co-constructed in one dialogue with what is co-constructed in a subsequent dialogue. Thus "knowledge", in this context can understood relative to the interaction (what the interlocutors mutually accept), rather than from a purely normative or external point of view. More precisely, it will be an invariant across interactive situations.

To go a little further on the notion of "co-construction", it could be said that it depends on an architectural metaphor, as if each participant contributed discrete 'bricks' of knowledge. Given that meaning is negotiated in interaction, this means that the 'bricks' themselves must be mobile, open to change, to alternative meanings. A better term might thus be that of "co-elaboration", given that this term encapsulates the idea of each "working on" (lat. *elaborare* = produce by work, or work out) the contributions of the other. Learning in interaction can thus be seen as a process of joint *appropriation* of knowledge that is co-elaborated in interaction. Appropriation occurs when interlocutors integrate each other's dialogical contributions into their own, or more precisely, when locutors reason from hypotheses based on propositions expressed by their interlocutors (Trognon & Batt, 2003).

In what follows, I therefore propose to understand the "social construction of knowledge" as referring to the knowledge that is co-elaborated, appropriated and mutually accepted in, by and across cooperative problem-solving dialogues.

Argumentation

As Rigotti and Greco have pointed out (see the introductory chapter to this volume), argumentation is a device for informing, for helping the interlocutor to recognise (the reasonableness of) something (I shall call this the "thesis", "**T**") after having given the necessary information (I shall call this an "argument", "**A**") for so doing. In order to understand the role of argumentation in the social construction of knowledge, we need to examine its specific characteristics in the context of collaborative problem solving.

Argumentative situations

If, as I have suggested, argumentative interaction can be seen as a means for attempting to solve an interlocutionary problem, then the thesis, T, whose acceptability is to be determined on the basis of an argument, A, will be a putative *solution* to a praxeological problem. At first sight, therefore, it might appear that the most simple *interactive argumentative situation* could be defined as follows: locutor L1 accepts a solution S, interlocutor L2 does not; L1 produces argument A for S (that thereby becomes a thesis, T) in order to enable (or oblige) L2 to accept S/T. This would be an 'adversarial' argument, since the goal of L1 is to convince L2. However, argumentative situations involving students are much more varied than this initial characterisation (e.g. Baker, 2002), and these variations are important for understanding the social construction of knowledge. The defining characteristic of argumentative contexts in students' collaborative problem-solving dialogues seems to be that of *diversity*, of solutions, attitudes towards them, and ways in which solutions and attitudes can be distributed across participants. Such diversity is associated with a diversity of argumentative *goals* (Walton, 1989) that go beyond the attempt to convince. Four possible argumentative situations are shown in Figure 1.

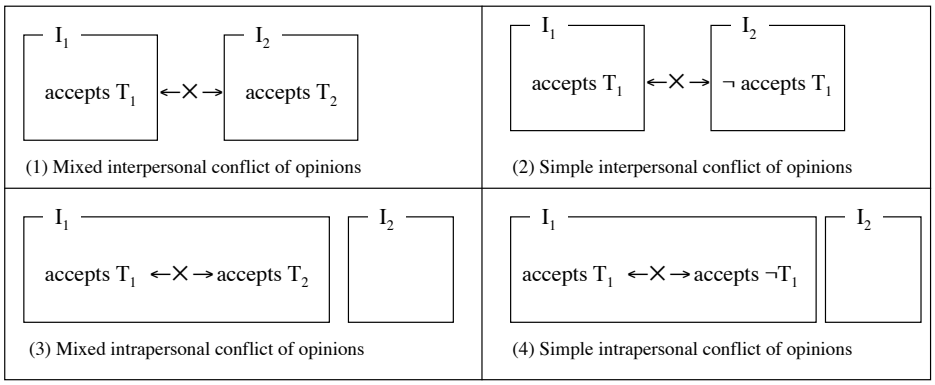


Figure 1. Four possible argumentative situations

Although situations (1) and (2) (shown in Figure 1) could give rise to adversarial attempts by I1 and I2 to refute each other's solutions and accept their own, this is not necessarily the case. Often, students are not very sure about their proposals, and in that case, each can provide both arguments for and against each of the solutions being discussed, in a 'cooperative' attempt to arrive at an intersubjective decision. In situations (3) and (4) a single student has expressed divergent solutions and his or her partner helps in trying to decide between them. In fact the symbol "←×→" in Figure 1

indicates a second requirement for argumentative situations, which is some perceived *need to choose* amongst diversity (otherwise, people could just 'live with' alternative points of view, or solutions to problems).

Solving interlocutionary problems

We can now look at how the interlocutionary problems are solved, assuming that students attempt to do so. Given that the argumentative situation comprises a diversity of solutions and/or attitudes towards them, the interlocutionary problem can be solved if the degree of acceptability associated to different solutions is modified, so that one emerges as the most acceptable. There are basically two ways of doing this: engaging in *argumentation*, or *negotiating the meaning* of the solutions being considered. Let us consider each briefly and in turn.

Producing an argument A with respect to a thesis T involves searching for additional information that is relevant to T. Once an argumentative relation between that information and T is established, the information becomes an argument for it (when it increases T's acceptability) or against it (when it decreases its acceptability). The information that is searched for can come from a variety of sources, including everyday life, previous schooling and of course, the problem solving situation itself, in which case arguments may correspond to the 'bases' (premises) on which the students initially proposed the solutions. An argumentative relation is established between A and T when it is possible to find some "warrant" (Toulmin, 1958) or "principle" (Grize, 1996) that authorises the transition from A to T. For example: L_1 states that (T) "Napoléon was a dictator". When asked why, L_1 replies (A) "He was Corsican". Supposing that L_2 accepts A, and the (contentious) generalisation (that renders explicit the relation between A and T) "Corsicans tend to be dictatorial", then if L2 accepts A, this would increase the acceptability of T for L_2. Whilst in everyday argumentation "warrants" often correspond to *doxa*, "what everyone knows", in school situations, they can refer to important abstract principles in a problem-solving domain. In that case, the interactive processes that require the argumentative relation to be made explicit can themselves be important for the social construction of knowledge. It should also be noted that the search for arguments can itself lead to better verification of solutions.

Negotiating the meaning of possible problem solutions solves the interlocutionary problem to the extent that it is no longer believed to obtain: if you change the meaning of a solution then you change its degree of acceptability as a solution. There are several ways in which such negotiation of meaning can take place. One way is to try to make the meaning of key notions referred to in the solutions more precise. For example, in the above example, L_2 could ask "but what do you mean by a 'dictator'?", and L1 could reply "someone who seizes power himself by military force". Another way is to dissociate notions from each other, which can be an effective argumentative strategy (Perelman & Olbrechts-Tyteca, 1958/1988), or alternatively to associate them (Baker, 2002). In the example above, L2 could say "Being a dictator and being dictatorial, in the sense of authoritarian, are not the same things; so I agree on the latter, but not the former". According to Naess (1966), making theses more precise is an integral part of argumentation itself. The requirement for expressing oneself clearly can be seen as part of the socio-relational pressures, requiring preservation of face (Muntig & Turnbull, 1988), imposed by socio-cognitive conflict (Doise & Mugny, 1981)

Playing the argumentative dialogue game

Finally, the (counter-)arguments that students do (not) express — and thus the quality of the solutions that they accept, together with the knowledge that they construct and the meanings that they negotiate — are in part governed by what may be termed "rules

of the argumentative dialogue game." These rules can be quite diverse. Some of them are logical (Barth & Krabbe, 1982), as in the case of the requirement for *coherence*: when two arguers L1 and L2 have opposed points of view, if L1 can show that L2 contradicted himself, then this would appear to disqualify L2's line of argument. Other rules seem to relate to a special form of *cooperative activity*, involving jointly working towards a determinate outcome of the debate. Thus, for example, arguing round in circles (incessantly repeating a given argumentative move, with no evolution in points of view) would seem to be precluded since it simply wastes everyone's time (unless, of course, what is at stake in the debate is situated elsewhere, on an affective plan, concerned with self- and other images, etc.). Similarly, there seems to be a constraint (incorporated in Barth and Krabbe's, *op. cit.*, formal dialectical models) to the effect that when one arguer's position is criticised, that person must defend their view against that criticism, otherwise, no genuine dialogue could be said to be taking place.

Intermediary synthesis

The social construction of knowledge can be understood in terms of what is co-elaborated, appropriated and mutually accepted in cooperative problem-solving dialogues. In order to understand the role of argumentative interactions in this context, they can be characterised as attempts to decide on alternative solutions, by transforming attitudes towards them. Attitudes can be transformed by searching for related knowledge that can function as arguments and by transforming the meaning of theses and arguments. This can be done not only in the attempt to defend or refute theses in an adversarial manner, but also in the framework of a more dispassionate and cooperative search for the (intersubjective) truth of the matter.

On the basis of the above brief theoretical discussion of argumentative interactions and the social construction of knowledge, we can now turn to the following two questions: what learning goals could be achieved by attempting to achieve argumentative goals, and what might be the interactive processes involved?

What could be learned from argumentative interaction?

It is not immediately obvious what could be learned from argumentative interaction (or, as I shall term in more briefly, "debate"), either for teachers or for researchers. For example, in 1999, two teachers of French (as well as researchers) wrote the following [my translation]:

> "Debates have been somewhat abandoned by teachers of French for a number of years, because of their low 'pedagogical output'. Apart from how to organise them … it is the objective to be attained that needs to be better defined."
>
> (Guerrini & Majcherczak, pp. 103-104)

In part, perceived low 'pedagogical output' may be due to the fact that the kind of learning that occurs in and from debates may be quite subtle, and difficult to evaluate. For example, if a teacher attempts to note students' participation in a classroom debate whilst it is taking place, this may be relatively imprecise. For this reason, learning from debates is commonly evaluated by requiring students to write some kind of synthesis of what took place and what they learned.

One way of getting to grips with pedagogical objectives of debating is to posit a distinction between process and product, between *debating skills* and what could be termed *knowledge of debates*.

Debating skills correspond in part to being able to respect the ground rules of argumentative interaction mentioned above, for example, defending one's view against

criticisms, and to that extent they may be seen as special cases of communication skills such as being able to express oneself clearly and relevantly in a discussion. In addition, students could learn various more or less technical aspects of argumentation, such as the strategies of leading the opponent to contradict himself, reversing the burden of proof, attacking a thesis directly rather than replying to arguments for it, redefining the thesis, and so on, as well as how to identify common "fallacies", or diverse species of logically unsound or pragmatically unfair argumentation.

But — I would claim — these technical aspects of argumentative discourse are much more associated with technical or specialised (e.g. legal) texts and debates rather than with students' debates. The problem, at least with adolescents rather than young children (cf. Stein & Bernas, 1999), resides not so much in mastery of general argumentative or spoken communication skills, that seem to be a part of everyday discourse, as in knowledge *of* debates themselves, of which students may have incoherent, irrational and sketchy understanding.

The nature of knowledge of debates can be understood in reference to what has been termed a *space of debate* (Baker, Quignard, Lund & Séjourné, 1999). A space of debate can be seen as a "problem space" that is *situated* in a specific communicative context, that of argumentative interaction. The situated nature of the space of debate can be seen from two aspects. Firstly, knowledge of a space of debate is by nature argumentative. For example, there is a difference between 'simply' knowing that "k: certain plants can be genetically modified in order to make them resistant to herbicides", and knowing that k can be both an argument for and against genetically modified organisms, when situated within the space of debate corresponding to the question of their advisability. Secondly, the type of knowledge that is expressed and elaborated in argumentative interactions is quite specific to them, given that the emotional, relational and dialogical context of disagreement leads to selecting or suppressing certain types of information as arguments. In other terms, if, in an argumentative interaction, the aim is to defend one's own view and refute that of one's partner, then the most effective arguments must be selected, each person's understanding is strongly influenced by their partners.

More concretely, learning objectives associated with a space of debate can be understood in relation to the following of its constituents, to be discussed below: *questions-theses, opinions, arguments, viewpoints and fundamental notions*.

One of the first problems that students face is to understand the precise questions that have and can be posed in a space of debate. Thus, for example, in the space of debate on euthanasia, one pedagogical goal would be that students are able to go beyond the question "is it right or wrong?" to identify other related and more specific questions, such as "is it possible to exert sufficient legal control over euthanasia?".

A second set of pedagogical objectives relate to personal opinions. In the first place, it is quite possible that students do not possess them (!). In a classroom experiment on debating the advisability of genetically modified organisms (reported in Baker et al., 1999), students were asked to write short texts arguing their personal opinions on the question, after having read associated documentation. "But Monsieur,", said several students "what should I do, I don't *have* an opinion on GMOs?". The point of the exercise was of course that they should develop such a personal opinion, and of course that it should be appropriately argued for. A second recurrent problem is that students do not understand the distinction between opinion and argument: stating a negative opinion does not correspond to an argument, and expressing an argument — perhaps hypothetically, "for the sake of argument" — does not necessarily imply a specific opinion. More generally, with many questions the goal would be that students

develop less “all or nothing” opinions, that are perhaps more subtle or conditional (“I agree if … but not if …”).

With respect to arguments, a clear pedagogical goal is not only that students know sufficient arguments in favour of their opinions, but also that they know the main arguments against, and even how they would reply to those counter-arguments. An associated general objective would be internal *coherence*, between the set of arguments and the opinion expressed.

Although argumentative interactions occurring during resolution of specific problems should generally draw on a single principle source of knowledge (e.g. in geometry, on geometrical and perhaps algebraic knowledge), debates on the level of society as a whole commonly draw on a variety of “viewpoints” with which the student should become acquainted. A “viewpoint” can be seen as encompassing a particular domain and value system, and is expressed by a particular social actor. For example, for the debate on human cloning, domains could be scientific (biology), ethical and economic, and value systems could originate in specific cultures, religions, political systems or other ‘visions’ (e.g. of the ‘value’ of scientific progress). Social actors might be “the European citizen”, “the government”, “the medical profession”, and so on. Similarly, a debate on tauromachie (bullfighting) could give rise to understanding that there is a global underlying conflict between “traditionalist”, “æsthetic” and “moral” points of view on this question.

Finally, such viewpoints, as well as questions-theses and arguments themselves, are associated with certain fundamental notions that could be more clearly understood as a result of debate. In the case of euthanasia, GMOs, cloning and tauromachie, the notion of “living beings” is generally at stake. Specific viewpoints will also have specific associated notions (e.g. economic, ethical, scientific) that could become better understood by the students. To that extent, learning from debates must be seen in the context of other types of learning in disciplines associated to the question debated. Debates could be seen as means for engaging students’ personal motivations in questions, prior to the deepening of specific aspects of them in other classes.

In summary to this section, I propose that the learning goals associated with pedagogical debates can be seen in terms of *broadening*, *deepening* and *refining* students’ understanding of argumentative knowledge in a space of debate. Their understanding is broadened when they know a greater variety of questions and arguments from different viewpoints; it is deepened when they know arguments on arguments on arguments … as well as the main underlying concepts; it is more refined when the students have a more clear and subtle personal opinion on the question, that is associated with an appropriate set of arguments. Such types of learning are relatively subtle and ‘costly’ to evaluate.

Let us now turn to the question as to the interactive processes by which such pedagogical goals might be achieved.

How might students learn from argumentative interaction?

Our discussion here can build on the above characterisation of the processes at work in argumentative interactions, operating in a space of debate comprising theses, opinions, arguments, viewpoints and notions. Recall that argumentation in the sense of debate is a dialogical game that transforms opinions with respect to complex sets of problem solutions, on the basis of expressing and negotiating the meaning of arguments. The three main classes of processes by with students might learn from argumentative interaction, to be discussed below, therefore concern opinion change, expression of arguments and negotiation of meaning.

Opinion change

Argumentation, in the context considered here, functions as a means of transforming the degree of acceptability of problem solutions, from the points of view of students, it influences which solutions will be retained or rejected, and thus types of learning that are understood in terms of measures of the quality of solutions. Two simple cases would be where the better-argued (defended) solution is mutually accepted, rather than others, and where a putative solution is refuted and thus not mutually accepted.

But such cases of argumentative "defense-acceptance" and "refutation-rejection" are problematic, in both theoretical and empirical terms. The first problem concerns the distinction between acceptance and belief (Baker, 2000a): for reasons relating to the dynamics of debate, a student may be obliged to accept or reject a solution, but may not genuinely in it in the first case, and may continue to believe in it in the second. The existence of such differences can be determined by analysing the dialogue following the argumentation sequence in question; but it nothing further is said relating to that sequence, the question must remain unanswered. A further empirical problem relates to the fact that there is nothing to guarantee that the best solutions are in fact retained and not rejected. In one case of problem-solving in physics, however, it has been shown that more elaborate physical models 'win out' as a result of argumentation.

Some results have also been obtained concerning acceptance and rejection of problem solutions in argumentative dialogues between students. For two different science problem solving domains (Baker 1996, 2003), it has been shown that students' attitudes are more often *weakened* (e.g. from initial acceptance to uncertainty or rejection) than *strengthened* (e.g. from rejection to acceptance) as a result of argumentation. In other words, instead of choosing the most acceptable solution, students proceed by elimination of 'flawed' solutions. This is understandable, given that, since the students' knowledge is supposed to be under construction in the learning situation, students are not likely to have firmly entrenched opinions to be defended (cf. Nonnon, 1996).

Finally, although opinions have been discussed above principally as all-or-nothing acceptance or rejection, in fact changes may be much more subtle. For example, as a result of discussing a question, students' initial unthinking certainties may be eroded, leading to unsureness and search for additional information (perhaps from the teacher).

In sum, the solutions to problems that students produce and retain can of course be influenced by argumentation, but their dialogues may need to be closely analysed in order to determine the extent to which retained solutions reflect individuals' beliefs. It seems to be easier to criticise and to reject, rather than to provide argumentative support, in exploratory collaborative learning situations.

Expression of arguments

It is now well established experimentally that students who *explain* their problem solutions to others, whether experimenters (Chi et al., 1989) or peers (Webb, 1989), can learn better by so doing. By rendering their problem-solving processes explicit, students may restructure their knowledge, or at least become able to produce a more coherent discourse (Crook, 1994) on the question at hand.

Such learning mechanisms could be at work in argumentative interactions, where explanations can take the special forms of replies to requests for clarification, or more generally, argumentative defenses. It should be noted however, that the nature and degree of elaboration of 'explanations' (justifications, arguments, …) will be very different in argumentative and non-argumentative interactive contexts (cf. Baker,

2000b). Whereas non-argumentative explanations may be quite extended, within a cooperative goal of 'helping' or informing (since what is to be explained is not generally disputed), argumentative explanations are influenced by the rules of debate, by the necessity to defend a view from criticism, and may thus be more restricted and focussed.

More generally, not only are explanations *qua* arguments strongly influenced by the interlocutionary problem context, but in the context of dialogue itself, there is something problematic with the notion of "making explicit" preformed ideas upon which the solutions proposed were presumably based. In certain cases it is clear that the information expressed as an argument does not correspond to the thinking upon which the student's proposal was based. For example, in the case study described in Baker (1999), one student 'made explicit' arguments for his solution that were based on constraints of the problem; however, it was clear that the (mis)understanding upon which is solution was based related to electrical current. Within that same study it was shown that in other cases, what students render explicit as arguments does seem to genuinely reflect that deeper underlying understanding.

What this means is that we should see explanation in interactive argumentation as a new kind of re-creative thinking in and by dialogue, which is *situated* in the dialogue context (cf. Edwards, 1993), rather than as a process of rendering explicit pre-formed views. Such a process could be positive in four main ways. Firstly, it quite simply involves extra reflexion on the praxeological problem, within the attempt to solve an interlocutionary problem that is triggered by the former. Secondly, such interactive reflexion can lead to greater internal coherence and elaboration in a student's own view. Thirdly, and again quite obviously, arguments that are expressed by locutors can then be acquired by their interlocutors. Fourthly, search for and creation of arguments could lead to a wider search throughout the problem space, and thus better verification of solutions in terms of problem constraints.

Negotiation of meaning

In an earlier section of this chapter it was mentioned that negotiation of meaning is an integral part of argumentative interaction. Engaging in argumentative interaction requires increased cognitive work (in comparison with non-argumentative interactions), that is in a sense required by socio-relational pressures. To state the point simply, social pressures force meanings to evolve.

Such transformations of meaning can occur in different argumentative contexts, and in different ways. Given our previous discussion of the space of debate, transformations concern potentially theses, arguments and underlying notions.

Theses are the responses to the question debated, which are defended or criticised by argument. If the question is "Is obligatory tipping in American restaurants a good thing?" (the example is taken from Walton, 1992), then one thesis is "No, tipping in American restaurants is not a good thing." As Walton (op. cit.) has pointed out, one rather large-scale transformation that can take place concerns the 'deepening' of the *questions* that are debated. Thus, in the just-mentioned example, an everyday occurring debate on the question of tipping (is it some kind of degrading 'charity' for the servers, or rather a nice way of rewarding good service?, etc.) changed gradually into a debate on a more fundamental or 'underlying' question: "to what extent should commercial affairs be regulated by legislation?". Such everyday examples could have correlates in educational situations: trying to solve a specific question in history, for example, could lead to discussing a question about the epistemology of science (what counts as historical 'proof').

A second macroscopic transformation (Baker, 2002) concerns the very way in which the space of debate is represented, or conceptualised, involving dissociating notions from each other or, to the contrary, associating them. This corresponds to what Perelman and Olbrechts-Tyteca termed “argument by dissociation and association”. Suppose that A says to B: “you behaved in a racist manner in excluding that person from the club”. In reply, B could try to counter-attack (e.g. by citing other occasions when B has been shown not to be racist), but another approach would be: “B: you must distinguish between racism and discrimination; my act was discriminatory, on the grounds of …, but it was not racist”. Such dissociations can of course be spurious or more or less motivated in particular domains. In physics problem solving, it has been shown that conceptual dissociations can enable students to ‘dissolve’ verbal conflicts by preserving a separate “domain of validity” for each student’s solution (Baker, 2002). Conceptual associations can similarly be means for finding compromises, by combining proposals under single concepts (e.g. “You say it’s air friction and I say that it’s loss of energy at impact; but they’re the same thing, they’re both a form of loss of energy”.)

There are two more argumentative contexts for negotiation of meaning: during argumentation and at its outcome. In the first case, students can be led to more or less extensively *reformulate* their argumentative defenses when under attack (Baker, 1996). In the second, when it seems impossible to decide between solutions on argumentative grounds alone (stalemate), then students may attempt to combine solutions into more or less superficial compromises.

In sum, argumentative interaction creates a special context that obliges reflection on and negotiation of the meaning of questions, theses, arguments and underlying notions. As with any aspect of collaborative problem-solving interactions, there is no guarantee that the meanings that students thus elaborate will be the preferred ones from a normative point of view.

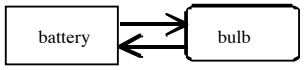
An example

I shall now present a summary analysis of a brief sequence from an interaction corpus, shown in Table 1, with the aim of illustrating many of the points made previously.

The extract is taken from a corpus of dialogues collected in a secondary school physics class (students aged 16-17 years). Dyads of students were asked to draw a diagram, called an “energy chain” (Tiberghien, 1996), to represent storage (reservoirs), transfers (arrows in the diagram) and transformations of energy in simple experimental setups. In the present case, Myriam and Raphaël (names changed) are drawing an energy change for a setup where a battery is linked to a bulb by two wires (the bulb lights up).

TABLE 1.

EXTRACT FROM A PHYSICS PROBLEM-SOLVING DIALOGUE (ENERGY CHAINS)

N°/Locutor	Dialogue
192/Myriam:	We'll put the transfer. And there, we'll do another one in the other direction, it's the second one 
193/Raphaël:	Ah no, no, no, no!
194/Myriam:	Ermm yes we will, but the circuit really has to be closed
195/Raphaël:	And yeah, but the battery
196/Myriam:	Ah yes, but there's no energy that's there's none when, in fact, the bulb doesn't produce energy, so the wire that comes back to the battery, it's just to close the circuit, it's not a transfer
197/Raphaël:	Yeah, but hang on, there's a negative pole. So it goes from the negative pole to the negative pole? And from the positive pole to the positive pole
198/Myriam:	No, from the positive pole to the negative pole
199/Raphaël:	That's exactly what I thought !
200/Myriam:	((laughs))
201/Raphaël:	I said to myself that there ! Well, right, there's another thingie there. It's not funny, so there
202/Myriam:	A positive pole, a negative pole
203/Raphaël:	there, there
204/Myriam:	We don't even have a battery
205/Raphaël:	Right ...
206/Myriam:	No but look, there really is a second transfer to close the circuit. But in fact, it's not a transfer, it's just to close the circuit, so that the energy can flow through
207/Raphaël:	Wait, the current circulates from the positive pole of the battery to the negative pole of the bulb, but that thing there, on the base …
208/Myriam:	And after it comes back from the positive to negative or from the negative to positive. Mmm
209/Raphaël:	positive, negative and to negative … Well yes there is, it's right, there are two transfers
210/Myriam:	But no ! there aren't two transfers
211/Raphaël:	Yes there are !
212/Myriam:	But no, because look, you can't, or else …
213/Raphaël:	But in any case, if there's only one, it doesn't work, I'm sorry
214/Myriam:	But yes, but that's all you keep saying
215/Raphaël:	Ah yes it is, in fact, there's only one mode of transfer, it's true
216/Myriam:	No, there's only one transfer because
217/Raphaël:	The mode of transfer it's …
218/Myriam:	Look, you go from the positive to the negative
219/Raphaël:	yes, yes, no but
220/Myriam:	after that it goes plus to minus, minus plus, yes, no, but what I mean to say is
221/Raphaël:	there's only one mode of transfer which …
222/Myriam:	It's a question of whether, I agree with you that there's a second wire that closes the circuit, but it's a question of whether it's a transfer or not
223/Raphaël:	No but ok, no, it's not a transfer

In the dialogue so far, the students agreed that the battery is a reservoir and the bulb a transformer of energy. The (praxeological) sub-problem here is: what is/are the transfer(s) of energy between battery and bulb? In line 192, Myriam proposes that there are two "transfers" (this precise term is important), one from the battery to the bulb and one from the bulb to the battery. This is rejected by Raphaël (193) and defended by Myraim in 194, with the argument that "the circuit has to be closed". Thus the initial argumentative situation (a simple interpersonal conflict of opinions, as in Figure 1) can be represented as in Figure 2.

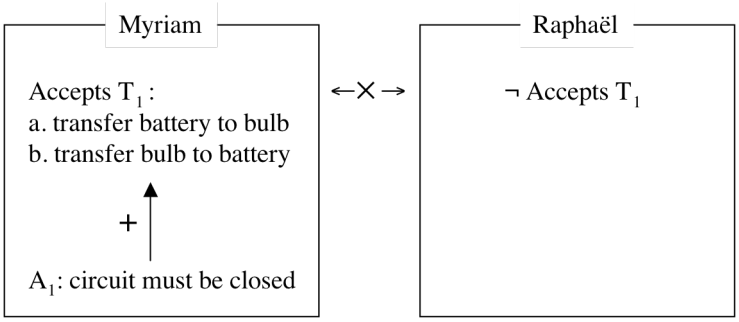


Figure 2. Initial argumentative situation

In the ensuing sequence, from 195 to 211, a suprising reversal takes place. Myriam retracts her thesis almost immediately in 196, thanks to a *conceptual dissociation* that she realises between **energy** and **electricity** (electrical current): the bulb doesn't produce energy … the wire is not a transfer (of energy), it's just to close the circuit. Notice that the thesis focussed on now has become *more precise*, being focussed on the transfer (arrow) from the bulb to battery: [T_1:a. transfer battery to bulb, and b. transfer bulb to battery] =precision=> [T_1': b. transfer bulb to battery]. Myriam now no longer accepts T_1'.

However, it seems that the reference to electrical circuits has triggered Raphaël's thinking; focussing on flow of electricity between positive and negative poles, he now accepts T_1, which he initially rejected (!). This is a perfect illustration of the *volatility of students' opinions* alluded to earlier in this chapter: since their knowledge is under co-elaboration, their interactive thinking is in movement, they are not (all, always) in a position to adopt entrenched opinions. During this sequence, Raphaël has '*explained'* his reasoning successively, in response to Myriam's rejection; but it must be said that this does not seem to have produced a good outcome.

At this stage (lines 192 to 211), the argumentative situation can be represented as in Figure 3. Notice that Raphaël has 'taken over' Myriam's initial thesis, together with her argument.

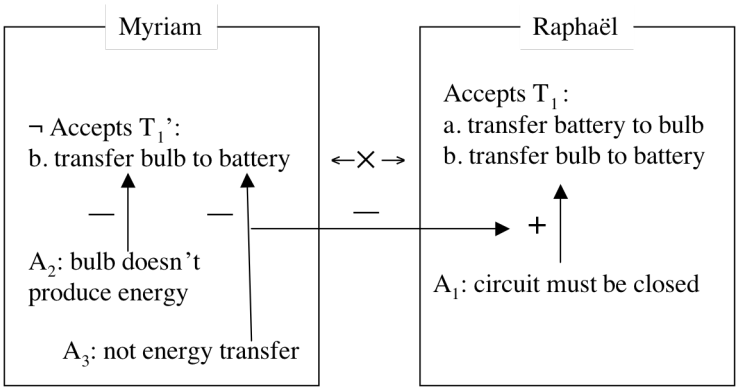


Figure 3. Subsequent argumentative situation (up to line 211)

In a sense, Myriam's change of mind can be seen as *negotiation of meaning of the argumentative link* between A_1 and T_1: together with *negotiation of the meaning of the term "transfer"*: it is true that the circuit must be closed (A_1), but this is not an argument for there being a transfer of energy from the bulb to the battery.

In the ensuing part of the dialogue (212 to 223), three additional points can be made. Firstly, in 214, Myriam makes an implicit reference to a dialogue rule ("that's all you keep saying"), to the effect that Raphaël's repetition of his argument is not productive dialogue. Secondly, in 215 it seems that Raphaël is also attempting to negotiate the meaning of "transfer" (of energy? A mode?), but this does not appear to come to a clear outcome. Thirdly, it appears that it is Myriam's more clear *reformulation* of her conceptual dissociation, in 222, that finally tips the balance in favour of Raphaël's rejection of the bulb-to-battery transfer thesis:

> 222/Myriam: It's a question of whether, I agree with you that there's a second wire that closes the circuit, but it's a question of whether it's a transfer or not

In conclusion to this brief analysis, the question arises as to what knowledge the students might have socially constructed (as this is defined earlier in this chapter) as a result of this argumentative interaction sequence, and how? On the basis of the above analysis, one possibility would be that the students' have refined their understanding of the differences between electrical current and energy. They seem to have achieved this as a result of an individually and collectively oriented search around a dialogical space of meanings, involving flexible changes of opinion on both sides, and negotiation of the meaning of the technical term "transfer". Their argumentative interaction appears as a combination of adversarial attempts to convince the other, and reflexion on the meaning of the problem(s) with which they are confronted.

Concluding remarks

Life is full of problems that we cannot solve alone. But when we try to solve them with others, the diversity of alternatives that can arise requires both finding arguments for and against, in order to decide between them and elaborating better understanding of the problem.

But such reflexive search for meaning and foundations does not necessarily guarantee better understanding. The most that can be said is that reflexion in interaction has taken place (which is itself not something to be taken for granted), and that it appears to have lead to joint appropriation of new ideas.

Such subtle changes occurring in interactions can be difficult to evaluate, both for educators and researchers. For the former, a more realistic alternative to interaction analysis might be to evaluate some joint or individual production (for example a textual synthesis) produced in the light of the debate. For the latter, the discovery of general interactive learning processes requires a painstaking inductive approach, across interactive situations.

In the final analysis, the design of interactive learning situations faces the problem of the inherent unpredictability of such interactions. General guidelines — but not failsafe rules — can nevertheless be proposed. The topic must be sufficiently rich to be debatable, the students must have the required prior knowledge, the global situation must lend itself to the appropriate communicative actions.

References

Baker, M.J. (1996). Argumentation et co-construction des connaissances. *Interaction et Cognitions* 2 (3), 157-191.

Baker, M.J. (2000a). Les attitudes et leurs révisions dans le dialogue : le cas de la résolution coopérative de problèmes. Psychologie de l'Interaction, N° 11 & 12, 229–265..

Baker M.J. (2000b). Explication, Argumentation et Négociation : analyse d'un corpus de dialogues en langue naturelle écrite dans le domaine de la médecine. Psychologie de l'Interaction, N° 9-10, 179-210.

Baker, M.J. (2002). Argumentative interactions, discursive operations and learning to model in science. In P. Brna, M. Baker, K. Stenning & A. Tiberghien (Eds.), *The Role of Communication in Learning to Model*, pp. 303-324. Mahwah N.J.: Lawrence Erlbaum Associates.

Baker, M.J. (2003). Computer-mediated Argumentative interactions for the co-elaboration of scientific notions. In J. Andriessen, M.J. Baker & D. Suthers (Eds.) *Arguing to Learn: Confronting Cognitions in Computer-Supported Collaborative Learning environments*, pp. 47-78. Dordrecht, The Netherlands : Kluwer Academic Publishers.

Baker, M.J., Quignard, M., Lund, K. & Séjourné, A. (2003). Computer-supported collaborative learning in the space of debate. In B. Wasson, S. Ludvigsen & U. Hoppe (Eds.) *Designing for Change in Networked Learning Environments : Proceedings of the International Conference on Computer Support for Collaborative Learning 2003*, pp. 11-20. Dordrecht : Kluwer Academic Publishers.

Barth, E.M. & Krabbe, E.C.W. (1982). *From Axiom to Dialogue: A philosophical study of logics and argumentation*. Berlin: Walter de Gruyter.

Chi, M.T.H., Bassok, M., Lewis, M.W., Reimann, P. & Glaser, R. (1989). Self-Explanations: How Students Study and Use Examples in Learning to Solve Problems. *Cognitive Science* , 13 (2), 145-182.

Crook, C. (1994). *Computers and the Collaborative Experience of Learning*. London : Routledge.

Doise, W. & Mugny, G. (1981). *Le développement social de l'intelligence*. Paris : InterÉditions.

Edwards, D. (1993). But What Do Children Really Think ? : Discourse Analysis and Conceptual Content in Children's Talk. *Cognition and Instruction* 11 (3 & 4), 207-225.

Grize, J.-B. (1996). *Logique naturelle et communications*. Paris: Presses Universitaires de France.

Guerrini, J.-C. & Majcherczak, E. (1999). *L'argumentation au pluriel : polyphonie, valeurs, points de vue*. Lyon : Presses Universitaires de Lyon.

Kerbrat-Orecchioni, C. (1990). *Les Interactions Verbales, Tome 1*. Paris : Armand Colin.

Lave, J. (1988). *Cognition in Practice*. Cambridge: Cambridge University Press.

Meyer, M. (1982). *Logique, langage et argumentation*. Paris: Hachette Université.

Muntig, P. & Turnbull, W. (1998). Conversational structure and facework in arguing. *Journal of Pragmatics*, 29, 225-256.

Naess, A. (1966). *Communication and argument. Elements of applied semantics* (English translation of *En del elementaere logiske emner*. Olso: Universitetsforlaget, 1947), London: Allen and Unwin.

Nonnon, E. (1996). Activités argumentatives et élaboration de connaissances nouvelles: le dialogue comme espace d'exploration. *Langue Française, 112* (décembre 1996), 67-87.

Perelman, C. & Olbrechts-Tyteca, L. (1958/1988). *Traité de l'argumentation. La nouvelle rhétorique*. Bruxelles: Editions de l'Université de Bruxelles.

Perret-Clermont, A.N. (1979, 5e édition 2000). *La construction de l'intelligence dans l'interaction sociale*. Berne: Éditions Peter Lang.

Perret-Clermont, A.-N., Perret, J.-F. & Bell, N. (1991). The Social Construction of Meaning and Cognitive Activity in Elementary School Children. In L.B. Resnick, J.M. Levine & S.D. Teasley (Eds.), *Perspectives on Socially Shared Cognition*, pp. 41-62. Washington DC: American Psychological Association.

Quignard, M. (2000). *Modélisation cognitive de l'argumentation dialoguée : etude de dialogues d'élèves en resolution de problème de sciences physiques*. Thèse de doctorat, Université Joseph Fourier Grenoble I, spécialité Sciences Cognitives.

Stein, N. L. & Bernas, R. (1999). The Early Emergence of Argumentative Knowledge and Skill. In G. Rijlaarsdam and E. Espéret (Series Eds.) & J. Andriessen and P. Coirier (Vol. Eds.) Studies in Writing: Vol. 5. *Foundations of Argumentative Text Processing*, (pp. 97–116). Amsterdam: University of Amsterdam Press.

Tiberghien, A. (1996). Construction of prototypical situations in teaching the concept of energy. In: G. Welford, J. Osborne & P. Scott (Eds.), *Research in Science Education in Europe* (pp. 100-114), London: Falmer Press.

Trognon, A. (1993). How Does the Process of Interaction Work When Two Interlocutors Try to Resolve a Logical Problem? *Cognition and Instruction*, 11(3 &4), 325-345.

Trognon, A. (1999). Éléments d'analyse interlocutoire. In M. Gilly, J.-P. Roux & A. Trognon (Eds.), *Apprendre dans l'interaction* [Learning in interaction], pp. 69-94. Nancy: Presses Universitaires de Nancy.

Trognon, A. & Batt, M. (2003). Comment représenter le passage de l'intersubjectif à l'intrasubjectif ? Essai de Logique Interlocutoire. *L'Orientation Scolaire et Professionnelle*, 32 (3), 399-436.

Toulmin, S. (1958). *The Uses of Argument*. Cambridge: Cambridge University Press.

Vygotsky L. (1978). *Mind in Society: The development of higher psychological processes.* M. Cole, V. John-Steiner, S. Scribner & E. Souberman (Eds.). Cambridge: Cambridge University Press.

Vygotsky L. (1986). *Thought and Language.* A. Kozulin (Ed.) Cambridge, MA: MIT Press.

Walton, D.N. (1989). *Informal Logic : a handbook for critical argumentation*. Cambridge: Cambridge University Press.

Walton, D.N. (1992). *Plausible argument in everyday conversation*. New York: State University of New York Press.

Webb, N.M. (1989). Peer interaction and learning in small groups. *International Journal of Education Research*, 13 (1), 21-38.

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