Milieu

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In this entry, we discuss the notion of milieu as interpreted by the French educational didactician Guy Brousseau (1997). We may generally define this concept in the following terms: the milieu is the actual material and symbolic structure of the problem at stake, which one has to deal with in order to solve this problem (Sensevy 2012). Here and hereafter, the term “problem” refers in a very general way to any situation in which one has to restore an equilibrium, in the Dewean sense (Dewey 1938).

Consider this example: at primary school, students are asked to reproduce a puzzle by enlarging it, in such a way that a segment which measures 4 cm on the model will measure 7 cm on the reproduction. The pieces of this puzzle constitute the milieu that the students face for this “enlargement problem.” This kind of milieu responds to three conditions:

1. The teacher’s intentions are inscrutable. Here, the students ignore the specific teacher’s teaching intentions. They concentrate on a pragmatic purpose (enlarging the puzzle), and at first they do not recognize the kind of knowledge (proportional reasoning) necessary to enable them to solve the problem. In this way, the students have to achieve certain autonomy.

2. The relationships within the milieu are pregnant and adequate. In enacting their activity, the students get feedbacks from the milieu, which helps them to make decisions about the strategies they use. For example, as they have to enlarge the puzzle in such a way that a segment, which measures 4 cm on the model, will measure 7 cm on the reproduction, they may decide to add 3 cm to every dimension. As a result of this strategy, the pieces are not compatible; the students may realize concretely that the additive strategy is not a good one. The milieu feedbacks are pregnant in that they focus the students’ attention on the relevance of the used strategy. They are adequate, in that an effective proportional strategy in making pieces will obtain their compatibility.

3. The knowledge at stake provides a winning strategy in problem solving. A specific knowledge (in the puzzle case, proportional reasoning) enables students to solve the problem. In this kind of milieu, the students can examine the situation, take a decision, enact it, and judge on their own the relevance of their strategy, according to the milieu feedbacks.

With respect to these three conditions (specially the first one), Brousseau (1997) draws attention to two fundamental features of such a milieu that he terms adidactical. First, it “lacks of any didactical intentions with regard to the students” (Brousseau 1997, p. 40). In our example, the signs provided by the pieces of the puzzle are non-intentional ones and opposed to the students’ goal (enlarging the puzzle) until they use the proportional strategy. Second, designing an adidactical milieu means taking into account not only the specific knowledge this milieu has to embed but also the current knowledge system with which students will approach this milieu. This is the reason why Brousseau defined the milieu as “the system opposing the taught system or, rather, the previously taught system”
In our example, students invariably act by adding 3 cm to every dimension. They face the adidactical milieu with an additive knowledge system, which provides them with their actual ineffective strategy.

Within this perspective, one may acknowledge the very nature of the teacher’s work. In order to describe the teaching-learning relationship, one has to be able to call for another concept, that of didactical contract (Brousseau 1997; Sensevé 2012). The didactical contract organizes the actual system with which the students deal with the milieu. In our puzzle example, one could say that students cope with the milieu within an additive contract, which has stemmed from the previous teacher and students’ joint action in mathematics. The didactical contract can be viewed both as a system of expectations between the students and the teacher and as the current students’ strategic system.

One might think that the notion of milieu is specific to a certain kind of teaching-learning process. It is true in the sense that a milieu cannot be designed without taking into account the specific knowledge it embeds. But the notion of milieu has a general relevance, in that it refers to the actual material and symbolic structure of the problematic situation, insofar that this structure may provide feedbacks for the student’s epistemic action. In this respect, let us consider an activity in the topic of mechanics (often taught in grade 11). This activity (Tiberghien et al. 2009; Sensevé et al. 2008) occurs while introducing the three laws of Newtonian mechanics. It aims at familiarizing students with the direction of the action and helps them to differentiate between action and motion. Then, the designers elaborate a milieu where directions of action and motion are different and observable even with common sense.

In this activity, the students have to throw and catch a medicine ball (heavy ball) and then answer a series of questions. The first one is “locate and note the moment(s) where you exert an action on the medicine ball; each time specify in which direction you exert this action on the medicine ball.” For the students, it is not easy to differentiate direction of action and motion when they catch the medicine ball at its lower point, and some of them say they exert a force downward. After a while, the feedbacks of the milieu (the way their hands have “to resist” to the ball) may help them to begin to conceptualize the situation accurately. This milieu (medicine ball) has a lot in common with the previous one (puzzle). It provides some feedbacks that are more or less immediately perceived by the students (the puzzle pieces do not fit together; the hands exert a force upward). One could term these kinds of feedbacks causal feedbacks. But there are other feedback possibilities in a milieu.

Let us consider now another situation, in which the milieu is a rather complex one. After having worked on the medicine ball problem, the students have to study the whole movement of the medicine ball within a specific activity (“Aristotle or Galileo?”). The students have to analyze different students’ answers to the task of “representing the forces which are exerted on the medicine ball (when it is going upward) represented by a point and noted M-B.” They are asked to study two proposals (summarized in Fig. 1), composed by two annotated vectors and a text:

One representation is correct from the point of view of the current model of mechanics (initiated by Galileo). The other representation corresponds to an intuitive analysis of the situation: according to this point of view (close to Aristotle’s) there is always a force in direction of the movement.

In this problem, the students have (1) to identify which type of answer refers to an Aristotelian viewpoint, (2) to identify the systems 1 and 2 which act on the system M-B and to draw a conjecture about what the additional force represents for the students (A) and why they need to represent this force, and (3) to rely on the interaction model in order to justify the fact that this
force does not model an action exerted by the medicine ball when it goes upward.

How is the milieu shaped in this situation? First, the students are confronted with a text from which they have to understand that the problem to be solved consists of analyzing two different student’s responses. Second, they have to pay attention to the fact that the student’s responses are vector representations. Third, while reading the text, students have to focus on a specific sentence (“according to this point of view (close to Aristotle’s), there is always a force in the direction of the movement”) in order to be able to work out the problem at stake. By referring to the previous sentence, they have to recognize this Aristotelian view as “incorrect.” Fourth, they have to refer their analysis to the moment when the medicine ball is going up. Fifth, they have to scrutinize the two representations in order to identify which group analyzes the situation “intuitively,” by drawing a force in the direction of the movement. Thus they have to consider the representation A and identify the vector F3/MB as expressing the Aristotelian viewpoint of a force in the direction of movement. They have to formulate hypotheses about the reason why the students need to represent this force. Finally, they have to justify the “fact that this force does not model an action exerted by the medicine ball when it goes upward,” by applying the interaction model. According to the current didactic contract, students are supposed to recognize that there are only the earth and the air which exert an action on the ball and that both of these actions are downward.

If we compare this kind of milieu to the previous ones studied (e.g., the “feel the medicine ball” milieu), we can acknowledge deep commonalities and striking differences. In both ways the students have to decipher and take into account a set of symbolic forms (the medicine ball and the hands pressure, the different meanings in the text of the problem), which refers to the nature of the problem at stake. Then they have to inquire into this set of symbolic forms in order to institute logic relationships between them and to transform them in an epistemic system of symbolic forms. But there is also a conceptual difference between the two kinds of milieu. In the first milieu (the “feel the medicine ball” milieu), students have to experience causal feedbacks by interrogating their own body, which functions as a milieu. In the second milieu (the “Aristotle-Galileo” milieu), they have to experience rational feedbacks, by inferring new meanings from the semantic and semiotic units they put in relation.

But above these commonalities and these differences, there is a deep kinship between the two milieus. Even though the teacher’s intentions can be used by the students for working out the problem, it is not possible for them to rely on this recognition to solve the problem. In order to solve it, they have to orient themselves in the milieu, then to inquire into the milieu and, in doing so, to encounter the fundamental meanings of the physics involved in this milieu. It is worth noting that the teacher’s work is crucial to help the students achieve their inquiry. The art and the science of teaching could be seen as a way of monitoring the relationship between the student’s work and the milieu.

Cross-References
▶ Agency and Knowledge
▶ Didactical Situation
▶ Epistemic Goals
▶ Transposition Didactique

References