SYSTEM DYNAMICS AT SCHOOL

Some operational insights for activities that draw from the authentic context of classroom and school life, within their own local area, while fostering an analogy with finitude, interconnectedness, capacity limits and the precariousness of the planetary system's balances.

Is awareness of complexity an obstacle or a necessary condition for civic action? It depends on the theoretical and value framework in which we intend to form and disseminate it. Certainly, as pioneered by Edgar Morin, 21st century educational systems cannot exempt themselves from taking it on. Not only because of the true complexification of society, which is the direct result of the extension and deepening of productive, commercial, financial, political, legal, artistic, scientific, technological, etc. interdependencies between human beings, whose growing and irreversible impact on the equilibrium of the Planet-system has led us to talk about the entry into a new era known as the 'anthropocene'. To motivate the imperative of complexity education, it is not even enough to add the new and growing scientific awareness of the objective complexity of nature, of the Planet itself, of the Universe in which we live, regardless of our intervention. What is even more important is that both an enormous risk and an enormous opportunity for the emancipation process of human beings - to which education intends to contribute in a specific and, so to speak, statutory way - may derive from this awareness and from this objective condition of our existence. The risk is that a sense of bewilderment prevails culturally, translates into self-justifying deresponsibilisation and ultimately into the submission of one's own intelligence to reassuring instruments and authorities; the opportunity is, on the contrary, that an incessant search for interpersonal and intercultural dialogue and confrontation emerges, a methodologically democratic and scientific attitude, a commitment all the more courageous and indomitable precisely because it is nourished by intellectual humility.

We believe that in order to seize this opportunity, it is essential to learn how to think and act from the methodological perspective of what has been called 'systems dynamics' since the 1960s, without which it is impossible to disentangle oneself, glimpse structures, and make decisions in a meaningful way in the general 'complexity' of the world. Certainly, mastering systems dynamics implies the acquisition of certain theoretical notions and, for this, we refer you to the splendid work of introduction to the method by Donella Meadows: *Thinking in Systems* (Chelsea Green Publishing, 2008), which we invite you to read. But from a pedagogical point of view, it is always fundamental to ask what educational situations can form that mental humus without which theoretical learning remains sterile. Therefore, in

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this article we try to propose experiments that help familiarise you with three conceptual pillars of systems dynamics: accumulation (or stock), flow and limits.

MAPPING OR INVENTORYING RESOURCES

You can start with a seemingly simple task addressed to the class group: try to identify everything that we use or that otherwise allows us to be together at school and to carry out our activities every day. It is important to leave enough time to give ample space for all individual ideas and responses, for dialogue and comparisons that may arise, encouraging the group not to leave out any details. Try to keep track, with particular attention, both of what tends to escape the students or pupils and of what emerges from them and surprises the teachers themselves, because it is precisely from the recognition of the 'unseen' or 'unseen by all' that scientifically-minded in-depth work can be triggered. In a school, reams of paper and meal calories, electricity and staff or students/pupils, the available financial budget and plants in the courtyard are equally essential stocks…

Once the collection of ideas is complete, a document (paper or digital) can be created to display all the resources identified as necessary. The document can of course take different forms depending on the school level and the teacher's intentions: from the simplest lexical inventory, organized e.g. by categories, to actual maps that map and define the resources from as many points of view as possible, e.g. according to physical criteria (material/type of material), the functions they perform, their location in the space of the building/classroom, the degree of priority the group assigns them, etc.

ANALYSING FLOWS, QUANTITIES AND ACTUAL PROCESSES

The next step is to introduce the idea of 'flow' and to think about each of the resources identified in terms of entry and exit from the school building according to different parameters: the quantitative measurement criteria, the most relevant time scale to measure the change in this quantity (hours, days, months, school years...?), the exact channels of entry and exit from school, the origins and destinations, the metamorphoses undergone in the transition to, inside and outside school.

All these parameters can give rise to multiple activities of analysis, comparison and representation of the quantitative and qualitative information collected. It is clear that in a primary school it will already be a sufficient objective to be able to reflect on the word "flow", on the class's pre-conceptions of its meaning in everyday experience, on ideas such as "resource", "waste", "transformation" etc., in order to produce, for example, a collective

poster that schematically represents certain flows identified as real in school life. As one progresses with age and school level, one acquires tools (mathematical, linguistic, scientific, historiographical, geographical, technical, etc.) that clearly allow her/him to represent the results of one's work in an increasingly detailed, rigorous and nuanced manner, to the point of potentially making it a real study that has real and useful spin-offs for the entire school community.

It is important, however, that as early as primary school this kind of work is conceived together with the pupils as truly functional to school life. Simply counting how many sheets of paper arrive in the classroom per week, how many are used and how many are thrown away, how many are recycled sheets and how many come from new reams, can lead the boys and girls to then think in terms of concrete actions to manage the flow more consciously. As one works with classes of higher cycles, one can get to really complex issues such as the quality and quantity of the energy source used to heat the school environment at certain temperatures (and the estimated CO2 emission), the hours of use of electricity in the classroom and the number of devices it powers (with an in-depth look at the sources from which the electricity actually used in the school comes), the number of people, hours of activity and different tasks involved in working in a school, and the search for indicators and methods (opinion poll, statistics, philosophical reflection...) to quantitatively and qualitatively estimate their results (without taking for granted what the results to be measured are... it seems to us much more interesting to understand "how many of us are happy to come to school?" or "How many of us feel that by coming to school we are learning and understanding more about the world?" and the like).

DEPICTING THE EXPERIENCE OF LIMITS

The following narrative scenario is described or read out to the class: for a certain amount of time, long enough to cause tangible effects, a certain resource necessary for life at school fails for reasons that cannot be immediately resolved; the school must go on anyway. The class is asked (individually or in groups; in written form or as an oral debate) to continue the narrative and tell what happens.

The various endings are then collectively reflected upon. In imagined endings:

- it is specified who and how the solutions, if any, were found and implemented?
- Have situations been imagined where we cannot agree on a solution?
- To what extent do the imagined developments follow lines of peaceful solution or assume scenarios of conflict or no solution?

- What discomforts created by the lack of the resource have been represented and captured?

- To what extent have stories been constructed taking it for granted that this resource is indeed indispensable, and to what extent instead have stories emerged that have called into question its necessity or found alternatives to it?

This activity can of course take place in synergy with the workshop on 'unequal resources'.

Another type of experiment may start with a different scenario that the class is asked to imagine: all flows out of the school are suddenly interrupted for a long and indefinite time, the class is asked to reflect on all the possible concrete consequences for life in the school and divide into groups according to each of them. Each group will have to come up with a technical contribution proposing how to reorganise that aspect of life in the school with the new constraint in mind. In the light of the contributions, the class will discuss and deliberate on an overall plan that, going beyond the scope of the simulation, could prove to be of practical use.