Review Article

Permaculture Resource System: An Activity Analysis in a Situation of Ecological Complexity toward a Didactics Perspective

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Abstract

Analysis of the instrumental activity of permaculture reconsiders the link between man and his environment, and puts forward the idea of working in partnership with living things, notably through the notion of substitution. From this more systemic, holistic, and dynamic perspective on work, an approach is proposed that combines the contributions of the instrumental approach with those of professional didactics. This approach, known as MSAIST (Methodology for Situational Analysis with Instrument Systems for Training), is a research intervention based on the co-analysis of the instrumented activity of actors, with a view to individual and collective development.

Introduction

Approaches centered on the notion of activity are concerned with the coupling of subject and situation, in the sense that subject and situation are so strongly interrelated that they largely constitute each other. Thus, the subject's development takes place in interaction with its environment. Not only do subjects build themselves by interacting with their environment, adapting to it through assimilation–accommodation [1], and adjusting to it by transforming their internal resources, schemas and knowledge [2,3], but also by transforming part of this environment into external resources that can be mobilized to carry out his activity [4], but also to

increase his future activity [5], a process that we understand within the framework of the notion of potential developmental situation [6]. In fact, activity can be directed either towards an immediate goal or towards a more distant one, notably with a view to a future subject [4,5].

Instrumented learning situations therefore appear to be many and varied: thought of from the outset as potential development situations [7], in the context of teaching and training for example, or inherent to professional activity, as another facet of activity with a productive aim. Rabardel and Samurçay [8] have long posited the dual dimension of activity: both productive and constructive. Thus, even if an activity is

(exclusively) productive, it can also be constructive, enabling unintentional forms of learning. This is what Pastré [9] calls incidental learning, which he situates as a property of activity. Studying situations that institute changes in the course of activity, particularly in terms of the resources mobilized, can provide access to this type of potential developmental situation.

But while the search for development is often on the side of the subject, there is one area where development is also on the side of the environment. We could conceive of all human works as a form of development of an environment that has been humanized, culturally and historically [10], and some have even gone so far as to identify what makes it an enabling environment, particularly in the context of constructive ergonomics [11]. But it is also a question of conceiving the idea of an environment that is also sustainable in the much longer term. It's no longer just a question of an environment (in the sense of ergonomics, and of the human and social sciences more broadly) that would enable the subject to develop, but also of a subject who in return would also act for the environment (understood in the sense of ecology). Thus, in the remainder of this text, and as researchers in the humanities and social sciences, we will make this distinction by choosing to use the term environment to describe its meaning as defined in the humanities and social sciences on the one hand, and the term milieu to emphasize its ecological dimension on the other; even if we understand with Cancian, et al. [12] for example, that it would be possible to describe it as a socio-ecosystem, in that these two elements are intertwined.

The question of development from situations that institute changes in the course of activity is grasped within the framework of the instrumental approach [4,13,14], where "tools are an integral part of situations and a stakeholder in action", transformed for their use "into capacities to act" [15], notably from the notion of resource systems [13,16,17]. The aim of this text is, therefore, to understand how changes are inscribed in agriculture, by studying the activity of permaculturists, and how this transforms even the finality of the activity, well beyond a merely functional aspect, to see if the permaculturist subject, through his or her own development, also acts beyond, with a view to a future, more sustainable environment, understood from an agroecological point of view.

So, in terms of the organization of the discussion that follows, we first present our theoretical and methodological approach, based on the instrumental approach, including a presentation of the FSRM, i.e. the Failure and Substitution of Resources Method [13,16,17]; while situating a few elements relating to permaculture. Next, we examine some aspects of the resource system of professional permaculture subjects. Finally, this investigation opens up a discussion on a potential orientation for FSRM and, more broadly, Substitution of Resources Situations (SRS), which serves as the basis for a broader proposal for training entitled MSAIST (Methodology for Situational Analysis with Instrument Systems for Training), which combines the contributions of professional didactics and those of the instrumental approach.

Thematic and theoretical framework

Permaculture: Working with living things: Permaculture is a seductive alternative to sustainable agriculture, which has received a fair amount of media coverage, even if its practices are still relatively confidential. "Inspired by natural ecosystems (…), permaculture establishes favorable interactions between the components of the sites it designs for humans and their needs, the territory and its characteristics, annual and perennial plants (…), animals, soils, microclimates, water, etc." [18]. In practical terms, its aim is to organize and promote opportune interactions between different plants [18-25]. This form of agriculture is thus an example of the alternative practices and ecological transition that follow from the original proposal of sustainable development: "development (taking) account of the reciprocal relationships between people, resources, the environment and development" [26].

According to the perspective of professional didactics [9], managing a crop in agriculture, even from a non-agro-ecological perspective, involves managing a dynamic environment [27]. This requires the farmer to regulate, supervise, and anticipate, so that he can adjust his actions to the dynamics of the plant system, sometimes over several years, as in the case of vines [28]. Working with living organisms belongs to this category of so-called dynamic situations, yet from an agroecology perspective, there is anticipation of a future that is both approached and extended [15]. Indeed, "the transition to a type of work with living organisms that considers living organisms as fully-fledged partners with whom we must act, makes work situations more complex, or more precisely, more complex again" [15]; not least because there is "growth, enlargement, diversification and densification of the phenomena at stake", requiring "finer, more local, more ephemeral diagnoses" (Mayen and Lainé, ibidem).

On the other hand, the systemic aspect, while well evoked in the context of an agronomic perspective and then in the paradigm shift of the agroecological perspective [12,14] constitutes the undeniable asset of permaculture (in the sense of systems ecology), is less emphasized concerning the aspect linked to the mobilization of the permaculturist's instruments, i.e. his own system of instruments [4]. This is what particularly appealed to us, and prompted us to mobilize the instrumental approach to tackle it. In previous work, we had developed a specific methodology – the FSRM, i.e. the Failure and Substitution of Resources Method – to analyze the systems of instruments and, more generally, of resources mobilized, and mobilizable, in situations by subjects engaged in a work activity. Our aim was to "analyze, beyond individual instruments, the whole represented by a subject's tooling, its rules and forms of organization, its genesis and evolution, etc., the (resources) that constitute it, and their status" [4], and we had thus identified various characteristics of resource systems. Based on an initial analysis of the activity of two permaculturists, we will discuss their practice of permaculture, through the prism of a systems approach to permaculturist resources.

Instrumental approach and methodology for analyzing resource systems: Our proposal with this text is to discuss the developmental character of an original situation in which we have already had occasion to place various subjects: the Method of Resource Failures and Substitutions, the FSRM [13,16,17]. In concrete terms, this method consists in establishing data grids, through observations and interviews, concerning the modalities of activity execution during successive failures of the subject's usual resources. This methodology, rooted in the instrumental approach [4], makes it possible to study the various instruments constituted by the subjects, and their relationships, forming a coherent and organized whole, to respond to the diversity and variability of the work situations encountered, henceforth referred to as a system of instruments, and more broadly as a system of resources [13,16]. The addition of the notion of resources to the initial proposal of a system of instruments [4] stems from the observation that various internal and external resources – such as personal memory, the collective, time, etc. – coexist with artefacts that are not necessarily the same. – coexist with institutional and informal artifacts, as means of action for the subject [13,16].

This conceptualization, in the continuity of the instrumental approach, interweaving the external and the internal to the subject, thus constitutes a new, original, and profoundly systemic unit. Indeed, resources, like instruments, are not given from the outset but are constituted as capacities for action by the subject itself, guaranteeing the power to act of a capable subject [5].

FSRM: a methodology for identifying the subject's resource system, with developmental effects

The FSRM is both a data collection device and an analysis grid for the data collected. This methodology itself constitutes a triangulation of methods.

The FSRM is carried out individually, with each subject involved, and is organized in four successive stages.

1 – Initial identification of situation classes and artifacts

These are constituted according to the subject's intrinsic point of view, which groups together in the same category all the situations for which he pursues the same object of activity [5]. Situation classes therefore call on a set of activities characteristic of a domain [5]. It is also a question of identifying the artifacts mobilized/mobilizable within their field of activity.

2 – Instructions and scenarios for the failure/substitution test

The following instructions are given to each subject: "We propose that you test, aloud, different scenarios in which you have to carry out (name of one of the situation classes) when one of your usual work tools has failed". The various artifacts previously listed are then successively listed and presented as faulty, and the task entrusted to the subject is to analyze and discuss the possibilities of carrying out the activity of (name of a situation class), substituting aloud in turn other potential resources for the faulty artifact.

3 – Dimensions addressed during the failure/substitution test

Several dimensions are in fact addressed during the failure/substitution test: the class of situation proposed, the usual artefact (in fact, each of the artefacts usually used for the class of situation considered), the functions to be substituted in the event of failure, the possible substitution artefact, and more generally the substitution resource(s).

Two final dimensions are questioned, directly related to the substitution resource itself. Firstly, the values of substitution: values direct the activity of subjects, and the analysis must therefore also focus on this dimension, which lies on the side of the subject's criteria. The values of substitution are obviously discussed at a functional level, but not only; they can also be subjective [29]: "The meaning of the instrument is also constituted by the functional and subjective values it can potentially take on within a subject's activity. It does not seem to us an exaggeratioń to say, transposing a formula of Vygotski's, that every instrument contains, in a singular form, the whole of the relationships that the subject can maintain with the reality on and in which it enables him to act, with himself and with others". Thus, they can be aesthetic, environmental (saving resources: electricity and/or fossil fuels, water, etc.), etc. Secondly, there are the conditions of substitution; this dimension, in turn, appears to be on the side of the situation.

4 – Using a grid to conduct interviews

The various dimensions addressed during the failure/substitution test each constitute a column entry in the FSRM, forming a grid that serves as a guide for conducting interviews, in terms of questioning and follow-up.

The data produced by the FSRM are therefore the verbalizations of each subject confronted with the different scenarios of the failure of the various artifacts. We then carry out a specific analysis of each of the protocols constructed, attempting to integrate the processed and coded data into the various final grids.

Identified characteristics of resource systems

Several characteristics of resource systems have been identified. The resources participating in the system are heterogeneous (characteristic 1). Functions may be performed simultaneously by several resources (redundancy) and/or may be the result of a combination of several resources (complementarity): these are system emergences (characteristic 2). The double characteristic of complementarity and redundancy of functions contributes simultaneously to the robustness of the system and to the flexibility and adaptability of its mobilization in relation to the variety and variability of situations (characteristic 3). Of all the resources making up the system, one in particular stands out as the organizer of the others: the system's pivotal resource (characteristic 4).

Resource systems specific to a situation class can be elements of sub-systems of larger systems (characteristic 5), e.g. specific to activity families. Consisting of several resources,

a pivotal subsystem of the system appears (characteristic 6), going beyond the concept of a single pivot and reinforcing the notion of subsystem. Finally, subject-specific values govern the mobilization of the system's various resources (characteristic 7).

The main contributions of FSRM and development perspectives

By way of an overview of the work carried out using the FSRM, it would appear that the systemic approach to resources is first and foremost a source for identifying systemic benchmarks and criteria for an anthropocentric conception of artifacts and work systems. It is also, in a way, a revealer of the structure of activity mediated by instruments, as well as a tool for reconstructing activity on the basis of subjects' discourse, as a subjective mirror of their own activity.

But viewed from a developmental ergonomics perspective, it is ultimately also a situation with developmental potential, involving instrumental or even conceptual geneses by subjects [9] that can be integrated into already constituted (resource) systems. Indeed, beyond the touchstone represented by the failure of the FSRM, the situation constitutes an invitation to subjects to engage in a situation of successive substitutions of their resources. This is what we now call Substitution of Resources Situations (SRS), which have been observed in various works, revolving around, for example (1) the simulated or real failure of a pre-existing resource in the resource system, (2) the imposed or voluntary abandonment of a pre-existing resource in the resource system, (3) the opportune or imposed encounter with a new artifact, such as the autonomous vehicle in its environmental dimension [30], car driving, with Waze [30], the provision of a chatbot [31], (4) or the emergence of an imaginary resource through explicit instrumental projection [31].

Our purpose today is to consider a part of this methodology (the FSRM) but above all more generally the Substitution of Resources Situations (SRS), as a basis for the construction of new instrumented learning situations, enabling (1) the subject to be drawn into a reflexive activitý on the means of his actions, through the emergence of substitute resources and the development/enrichment of his resource system and (2) to highlight a new capacity of the capable subject, i. i.e. substitutability, i.e. a capacity not only to envisage new resources but also, as our case study shows, to reconsider the aims of activity, to project instrumental geneses with a view to a future subject in the making. A capacity that, once uncovered, can provide an anchor for formulating the perspective of an MSAIST (Methodology for Situational Analysis with Instrument Systems for Training).

Permaculturists' activities through the prism of a systemic approach to their resources

Our analysis of permaculture practices is not based on the failure of permaculturists' resources (as the FSRM invites us to do), but rather on a reading of their activity through the lens of a systems approach to resources. This work was initiated

from two distinct and complementary angles. Firstly, from a perspective extrinsic to the subject, through the consultation of video testimonies of permaculturists and documentaries, books on the practice of permaculture, observations of spaces, photos, and diagrams of permaculture spaces, and so on. Secondly, from an intrinsic point of view: several interviews with 2 permaculturists were carried out, as were sequences of observations of the activity of these permaculturists, analysis of the verbalizations elicited, and the involvement of an FSRM with one of them, but of which we will only present a few results here.

We begin by highlighting the systemic dimension intrinsically present in the practice of permaculture. We then present some of the characteristics of resource systems found in the activity of permaculturists. We also return to the importance of observation and the act-no-act duality. Finally, we discuss the substitution of instruments, which is not only driven by the functional dimension. We will thus discuss their practice of permaculture from a double systemic angle (Bourmaud, 2018), both resource systems and ecological systems.

An intrinsically systemic farming practice: The cultivation area of one of the permaculturists we met is configured into ten or so plots, i.e. cultivated sections of the plot. Forming large rectangles of around 5 x 1 meters, they are delimited by alleys, themselves covered with organic matter (Figure 1). The beds feature a variety of plant associations, constituting different cropping sequences. On the first bed (Figure 2), for example, four vines of string beans, clinging to chestnut canes joined at the top, form the corners of a square measuring less than 1m2, with tomato vines on the south-facing side, celeriac on the shady sides and a cauliflower in the middle. The permaculturist declares: "It may not produce as many vegetables as if they

Figure 1: Photograph of covered walkways.

Figure 2: Photograph of the first organic bed.

were grown separately, but together they should make up an interesting quantity and justify the space saving".

A second bed features a row of peppers on the north-facing side, a row of peas on the south-facing side, which progressively cling to dead wood branches planted in the soil, green and purple basil between the two rows, lettuce between the peppers, and at each end of this bed, ground pear (a perennial plant) and nasturtium (which acts as a pest bank, guaranteeing the presence of ladybugs, effective aphid predators throughout the growing zone).

An analysis of these first two plots, created by the permaculturists, reveals the principles of permaculture: mixed and diverse crops, concentrated on the ground on the one hand and vertical on the other; soil aggradation (enrichment of the soil through the degradation of organic matter); harvesting spread out over time; water saving through the proximity effect of certain plants; etc. More generally, we also find deeply systemic principles, in the sense of systems theory [16].

More generally, we also find deeply systemic principles, in the sense of systems theory [16]. Firstly, there is a dual consideration for both the "primary functions", intrinsic to each plant, and the "systemic functions", favourable or unfavourable for the system, known as emergencies or constraints (Bourmaud, 2017). Planting beds do indeed appear as systems in themselves, and as subsystems of the more global system that constitutes the growing area.

A system of resources: The resource systems of each of the permaculturists observed show considerable heterogeneity (characteristic 1 of resource systems), including permaculture principles (such as patterns, knowledge, etc.), artifacts such as gardening tools, and others with more informal uses, such as beetle irons and twigs used as stakes. There's also a cropping

diary for planning their activity, which forms the backbone of the resource system of the permaculturist to whom we gave an FSRM (resource system characteristic 4). This agenda of crops even assumes the status of a pivotal transitional instrument.

In the particular dynamic space-time of permaculturist activity, it may indeed be relevant to use the notion of the transitional instrument [32]. An instrument is transitional if it acts as a link or transition between one spatiotemporal situation and another. An instrument becomes transitional when a subject attributes to it a special status as a memory aid, a witness, and a repository of the traces of a lived experience. The cropping diary of the 2 permaculturists thus integrates data from multiple sources, enabling decision-making and action, mainly at the level of cropping beds, both spatio-temporally and organizationally. Entries are made for actions to be carried out, usually on a day-by-day basis, but at least for the week.

It provides a tool for planning activities: "It's my lighthouse", says one of them. These actions were included in the yearbook by the permaculturists themselves, as a compilation and synthesis of the various information drawn from their other resources, and in support of last year's yearbook.

In addition, the cropping diary organizes and articulates the mobilization of the system's various resources, such as plant variety charts or association charts (paper documents and/or websites), a cropping diary produced by his permaculture training organization, descriptions of typical cropping sequences, various books, an Excel stock file, and so on. About this, one of the permaculturists says:

"In fact, it's like a guide to more precise and complementary information".

These are in fact characteristics 5 and 6 of resource systems, relating to (1) the notion of system nesting, and (2) the system's pivotal subsystem: made up of several resources, it goes beyond the concept of a single pivotal instrument and reinforces the notion of subsystem. In addition, numerous complementarities and redundancies appear (characteristics 2 and 3 of resource systems), ensuring the system's robustness and adaptability, such as the information on plant development included in its cropping schedule, as indicated in the descriptions of cropping sequences or in certain plant variety tables. Finally, values specific to the subjects (characteristic 7 of resource systems) directing their activity govern the mobilization of the system's various resources, such as the aesthetics and fine organization of the crops with flowers and beds, and manicured alleys; limiting the workload generated by each and every crop sequence/s, thoughtful induced water consumption, selling vegetables to a network particularly attentive to reasoned agricultural production, etc.

The question of observation, action and non-action: The permaculturist to whom we proposed an FSRM made a number of statements that particularly resonated with us:

"In agriculture, we intervene dramatically too much", yet "things find their place".

Decentralization on the part of the worker, who acts with the living, requires forms of observation aimed at establishing diagnoses of the processes at play, in order to understand their dynamics. This activity is similar to that of taking into account a dynamic environment, which requires conceptualization with a view to anticipation. In this respect, it can sometimes be worthwhile not to act, for example, by allowing the living system to return to equilibrium on its own, or to "correct" imbalances on its own, due to the systemic aspect of relations between living organisms and their environment (due to emergences or constraints).

While observing and diagnosing the situation is part and parcel of agricultural work, what's different in agroecology is not so much that you have to observe, but what you observe. This activity of paying attention to the environment enables the professional to develop new, finer-grained clues:

"Once you've met a plant, you'll see it everywhere afterwards!"

This not only extends the temporality to be taken into consideration but also "densifies space", as Mayen and Lainé (2014) put it. Moreover, to act or not to act is obviously part of the constructive dimension of the activity, but it's not outside the productive field:

"Observation may seem non-productive as a first approach, but in fact it serves", as a true value of the permaculturist's activity.

Finally, the system observed seems to expand, over time and through the observations themselves:

"One's own system, the one we've designed, is the one we observe at the beginning, but then it expands, we observe bigger and bigger systems, considering the other spaces around, and gradually we'll look at neighboring plots and the wider living territory".

Working with living things [15] requires an understanding that the perimeter of action must expand. It implies a decentralization on the part of the worker, since the plot worked on is part of a whole that goes beyond simple production issues, since the ecological approach, on the one hand, densifies space without dismissing organisms, processes and phenomena, where "cow dung is also an ecosystem" [15], and on the other hand, extends to more temporalities, upstream and downstream of the action. To illustrate the notion of parts of a whole, the planks each constitute a subsystem of the more global system represented by the cultivation area. In terms of temporal extension, the cropping diary - a pivotal transitional instrument - enables the permaculturist to make decisions and take action, both on a daily basis and from one year to the next.

It's also common to:

"Leave a piece of land alone, to see what happens (...) the forest being the model", so "let the plants travel".

In this way, there's plenty of room for experimentation that is not controlled by the permaculturist. In addition, the permaculturist expresses the fact that "we make mistakes and that's normal, we just have to give ourselves the means to see it, by observing, without doing anything, just like a curious person". It's all about understanding the effects of certain actions and non-actions.

Substitution, beyond a functional approach: Finally, in the course of our discussions with permaculturists, we were led to discuss the notion of substitution, not strictly in the context of implementing an FSRM, but at a more general level. In particular, it wasn't a question of discussing the substitution of one of the permaculturist's resources, but of what was at stake in terms of the object of the activity in the mobilization of the spade versus the grelinette, which was the subject of certain exchanges.

As a reminder, the spade is an "instrument consisting of a broad, flattened, sharp iron blade fitted to a long wooden handle, and used to turn over the soil" (CNRTL). A gardener's tool, its purpose is to turn over the soil to aerate it and prepare it for cultivation. However, from the point of view of permaculturists and permaculture in general, this tool degrades the quality of the soil, by upsetting the strata of living organisms underground. For this reason, permaculturists prefer the grelinette, as he defined as:

"A two-handled tool with three or four tines for easy working of the soil. Once it's in the ground, we use the handles to move it back and forth, thus decompacting the soil".

While a first reading might lead us to conclude that this is in some way a substitution of one resource for another, in our view it's ultimately more complex. In fact, it's not the same function that's being substituted here: with the grelinette, we're talking about "decompacting the earth", i.e. opening it up and aerating it without turning it over. It's an artefact that should enable us to act in a way that's more respectful of the soil. With this change of function, it's the very re-elaboration of a new object of activity. With the grelinette, we see a strong dialectic between instruments and objects of activity, "driven by goals, pushed by motives and framed by values" (Rabardel, 2005).

Thus, one of the perspectives of this type of exploration with permaculturists is to be able to discuss the FSRM (Failure and Substitution of Resources Method) afresh to sketch out the contours of an expanded methodology, which we develop in the following discussion. Beyond taking into account only system failures on the one hand, and the functional efficiency of the various instruments/resources on the other, we need to consider respectively (1) the desired potentialities, the substitution resources as it were, (2) and the goals and motives guiding the subjects' activity, and the mobilization of resources.

A Soviet author such as Rubinstein was able to emphasize the importance of motives and goals in the subject. He wrote: "It is inevitable and legitimate that man, as a social being, should have motives for activity that go beyond the immediate aims of his actions. Everything man does not only leads to a direct result in the form of the product of his activity but

also to a social effect: by exerting an influence on things, he also influences men. This is why, in human beings, the social motive is, in principle, inscribed in activity; the individual aspires, in fact, to fulfill his obligations, his commitments, his social duty, and also to self-fulfillment, to social recognition" (Rubinstein, in Nosulenko and coll., 2005). According to Nosulenko and Rabardel [33], "Rubinstein takes a stand against the absolutization of motives; he analyzes the displacement of motive not towards the goal, but 1) towards the activity, 2) towards one of the results of the activity".

Discussion and outlook

Ecological issues: Acting for and with living organisms

Working with living things from an ecological perspective involves a series of practical and epistemological ruptures, in which organisms are no longer merely means, but also subjects to be cared for and agents of action [15]. This "entails the need to think and rethink what is to be learned and perhaps the ways in which it is learned" [15]. Notably, based on a reading of Hache (2011), taking up Dewey's [34] notion of a continuum of means and ends, Mayen and Lainé [15] indicate that "goals, then, are no longer defined solely on the basis of what they are aimed at a priori, but of a redefinition that reconstitutes them in terms of the other ends aimed at and in terms of the consequences that the use of certain means might have".

"Working with the living in a sustainable perspective, then, implies taking into account a plurality of ends, producing, but producing while protecting the living entities concerned, maintaining them in their integrity as living beings, reasoning the consequences of the choices of actions and defining the choices according to the goals of the latter" [15]. Thus, according to Mayen, action is distributed with partners that are living organisms and phenomena as well as other human users of the same environment, whose purposes are also to be taken into account, even if this question would merit further questioning, for example, the fact that not all living organisms are intentionally our partners.

This strong idea was deployed in relation to the evolution of the profession of "coordinator of natural areas and hiking trails", experiencing a transition between two models of the profession, the old, centered on nature protection and species preservation, and the new aiming at "the search for a man-nature partnership" to reconcile socio-economic development and ecological balances, a movement presented in the work of Cancian, et al. [12]. It is this idea of "man-nature partnership", beyond a simple "man-nature interaction", that we wish to highlight in the context of our study, also based on the activity "on, with and for the living" [15]. But the question that arises is in what way and how it is relevant to transpose this point of view to agriculture.

How can we support development at work?: "Work is normally man's most essential need. To work is to reveal oneself in an activity, to give shape to one's project by concretizing it in materialized products. To work is to enrich and fulfill one's being by objectifying oneself in the products of one's work, to be creative, and thus to experience the greatest happiness

in principle accessible to man. Work is the fundamental law of human development" (Rubinstein, cited in Nosulenko and Rabardel, 2007, p. 157).

If the function of work is to enable this revelation of man to himself, then we understand why "work is the fundamental law of human development". The aim of vocational didactics is to work towards the emancipation of actors through their own development. It aims to enable the development of their "power to act" [5,35,36]. But aren't the lively questions surrounding the sustainability of the environment's resources also prompting us to work towards the development of a "power to react", which also considers in all its fullness the purposes of the living world, and decides to work in partnership with it?

From a more pragmatic point of view, understanding the principles underpinning the permaculturist's system of instruments/resources could enable us to better design training systems based on the analysis of actors' activity [37], with a view to answering a question posed by Fleury and Fabre [38] about education for sustainable development: "how can we train for responsibility through a pedagogy of inculcation, how can we awaken to complexity through a somewhat simplistic moralism? In particular, if the intelligibility of conceptualization in action [2,3] by stakeholders, inscribed in the complexity of ecological issues, takes into account: (1) the "invariants of the situation", with a view to adjusting to the process of the living being understood as a dynamic environment, and beyond that as a partner in its own right; and (2) the "invariants of the subject" referring to its system of desires, motives, values and goals [36].

Towards a proposed system: MSAIST: The issues at stake for training prompt us to propose a system entitled MSAIST (Methodology for Situational Analysis with Instrument Systems for Training). The aim of this methodology is to constitute a research-intervention, the main thrust of which is to contribute to an approach enabling the generation and deployment of data collection methods relating to the analysis of instrument-mediated activity situations, with a view to training, and more broadly to the development of subjects and collectives. More specifically, the aim is to be able to involve the actors participating in the study in order, on the one hand, to report on their instrument systems, and on the other hand, to construct training situations based on the analysis of instrument-mediated activity in work or training-learning situations (Gillet, et al. 2013).

This approach falls within the framework of research-intervention-collaboration, involving professionals in defining with researchers the elements and aims of the analysis with a view to developing work collectives [39], while mobilizing the framework of continuous design in use [29]. Beyond analyzing resource systems in training [17], the idea is to develop a new perspective in design didactics [40], through the idea of proposing design situations as sources of training, inspired by the contributions of professional didactics [9,41].

The theoretical framework used is twofold. Firstly, it is based on Rabardel's instrumental approach (1995, 2005),

complemented by work centered on the notion of a system of instruments or system of resources [13,16,17], It is also part of professional didactic engineering [9].

The potential benefits of such a system: Offering training situations designed on the basis of an analysis of the resource systems mobilized by the actors in a class of work situations, on the one hand, and proposing SRHs within the framework of the same class of situations studied, on the other, can contribute to deploying "potential spaces for problematization" according to Mayen and Lainé's expression [15]. In our view, this problematization could even take place at two levels. Firstly, the analysis of activity for a class of multi-instrumented work situations, in order to account for the resource system of one or more actors, can be a source of development for the actors participating in the study, in that it leads them to have to identify what is problematic in the situation studied, or even better, to choose to study a situation that precisely poses a problem for the community or work collective.

This is in line with the systemic, holistic dimensions of activity analysis. Secondly, based on this initial analysis of activity, we can create a training situation - for example, a case study posing a question - that can be proposed to different workers, novice or experienced, in order to understand the multiple ways of considering and resolving this case, but above all the system of instruments mobilized to deal with it, among other actors, in order to share their ways of doing and thinking about this type of problem-situation.

Certainly, and this is very much what professional didactic engineering proposes, which designs training situations based on professional situations deemed problematic, and has already been mobilized, for example, in the training of agricultural advisors to meet the challenges of agroecology, using the "disturbed" and "disruptive" social situation of tour de plaine to "shake up, shift and displace" advisors. The aim is to create a cognitive conflict between them and their advisory routines, addressed to the farmer, so that they, in turn, can lead him or her to question, beyond the fact of "understanding the state of the plot and suggesting actions to be implemented while reminding him or her of the technical decision rules derived from references", allowing "the farmer's conceptualization of his or her system and conduct to emerge" and fostering exchanges [42].

Thirdly, yet another problem can be added, and constitute a further step towards the development of a capable subject, which is that brought about by SRS, consisting in proposing to the subject to rethink his instrumented activity without recourse to his usual resource, in order to invite him to reconfigure his resource system.

Potential extensions: But beyond the contribution of activity analysis to sustainable development, what contribution does the latter make to the approaches of vocational didactics and ergonomics? For example, how can we train by linking ergonomics and sustainable development? For example, since 2018, an annual day has been organized for ergonomics Master's students around the theme of "ergonomics and sustainable development". Based on presentations of an ergonomics PhD thesis and an ergonomics Master 2 internship, the first day dealt specifically with the issue of waste management.

The day thus provided an opportunity to discuss and deepen a recently defended Master 2 work). On a more general level, the day also enabled current students to take a fresh look at their own Master 2 formative interventions, drawing on the notion of the "sustainable development lens", put forward by Bourmaud [43]. This notion invites us to conduct ergonomic intervention by identifying the criteria and values linked to sustainable development issues [44] that motivate subjects' activity, without necessarily being explicit for them. These criteria and values are just as much vectors and opportunities for collectively constructing intervention recommendations and perspectives. How might these ergonomic initiatives inspire others in vocational didactics?

Conclusion

We began our introduction by recalling that the notion of activity refers to a coupling between subject and situation, and more broadly between subject and environment, and we put forward the idea that it is no longer a question of an environment that only allows the subject to develop, but also of the place of a subject who in turn is able to act for the environment, understood as a milieu. To go a step further, wouldn't we have to return to the idea that man is not only in interaction with his environment but also in a kind of necessary fusion with it, to the point where Dewey [34] prefers to speak of "participation", whereas Ingold [45], following Dewey, goes so far as to speak of "re-entering into correspondence" in the context of what he calls an anthropology of education understood as a practice of attention. For "it is by being attentive to one another along the way that beings correspond" [45]. If we take the coupling of subject and living environment, could we not advance the idea with Ingold of considering them as "co-correspondents", in the sense that dialectically they "respond" to each other? But in order to respond to each other, we need to understand the living being and its characteristics, as we have attempted to do through a systemic approach [46,47]. Alternatively, wouldn't it be better to return with Weil [48] to the idea of rootedness [49]?

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