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The Contribution of Professional Didactics to the Balance of Biodiversity in Small Tropical Islands

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Abstract

What is the role of social and human sciences in the debate on the exploration of the biophysical dimension of tropical island ecosystems, their humanisation and representation modes, as well as their consequences for resources related to biodiversity? Professional Didactics could develop some answers. This science ascribes a fundamental role to people's experiences in understanding their actions. This paper has given serious consideration to the issue of how Professional Didactics can help us understand biodiversity. It has focused on understanding what people actually do based on what they have been taught to do, through the definition of fundamental concepts of Professional Didactics and some examples of research being conducted in Martinique.

Keywords

Tropical Island Ecosystems, Biodiversity, Professional Didactics, Schema, Martinique

1. Introduction

The aim of this lecture is to highlight the role of social and human sciences, in particular Professional Didactics, in the debate on the exploration of the biophysical dimension of tropical island ecosystems, their humanisation and representation modes, as well as their consequences for resources related to biodiversity. A fundamental principle of Professional Didactics (PD) is that a person's actions contain much more than what they have learned academically (at school or through professional training). This principle ascribes a fundamental role to people's experiences in understanding their actions. One may wonder what education and training sciences could contribute to our islands' erosion problems. To help

answer this question, this paper has given serious consideration to the issue of how Professional Didactics can help us understand biodiversity.

What can Professional Didactics bring in people's daily lives in terms of biodiversity issues? This is the question this lecture will try to tackle. It will try to develop some answers by drawing on the results of research already being conducted in Martinique. The present author has focused on understanding what people actually do based on what they have been taught to do.

This presentation will comprise three points:

- What is Professional Didactics (PD)?
- Examples illustrating PD approach and methods.
- What can PD bring to the balance of biodiversity in small tropical islands?

After a quick theoretical overview of PD concepts needed to understand the subject, the paper will give three examples of analysing human activities, which illustrate this principle. Using relevant elements drawn from these examples, it will then develop dimensions that could judiciously be mobilised in order to explore the humanisation and representation modes that would help ensure a certain balance of biodiversity in the ecosystems of small islands. First, the theoretical and conceptual frameworks of professional didactics (PD) are presented, then examples will be given to illustrate the development of certain concepts relevant to PD's contribution to the analysis of small islands' biodiversity for the purposes of coviability. As part of the attempt to understand coviability, it will be shown how a PD-based analysis helps reveal fishing practices which respect the environment and would benefit from being theorised so they may be taught in schools and training institutes. Finally, as part of a wider discussion, an ongoing project developing this approach will be highlighted. The article's conclusion will be opening up a new field of academic collaboration which uses PD methods to produce new knowledge in the service of small islands' coviability.

2. What Is Professional Didactics (PD)?

Professional Didactics is a discipline that has stemmed from the reality of the work of professionals. The example that will be given in order to present the concepts that are essential to the present subject is taken from the world of industry. It was Pierre Pastré who provided this example, which lies at the boundary between the industrial and economic worlds [1].

The aim of Professional Didactics is to analyse people's work with a view to developing their professional skills. It emerged in France in the 1990s, at the confluence of practices, adult training, and three theoretical currents: developmental psychology, cognitive ergonomics, and disciplinary didactics, namely the didactics of mathematics.

It is based on the theory (inspired by Piaget, developed by Vergnaud) of conceptualisation in action.

Its general hypothesis is that human activities are organised in the form of schemas, whose central core consists of pragmatic concepts. We will return later to the

definitions of these concepts.

Professional Didactics seeks a balance between two perspectives. On the one hand, it reflects on the foundations of human learning from a theoretical and epistemological point of view—this is its dimension connected to understanding and axiology. On the other hand, it seeks to operationalise its analytical methods so as to use them to devise training—this is its didactic dimension.

It thus aims to understand human activities, and to shape or change practices. It is therefore the science that studies how analysing the activity of a professional can form the basis for training professionals.

The goal of Professional Didactics is thus to study people at work in order to train them [2]; its objective is to try and understand how professional skills are acquired and transmitted, from a developmental and epistemological perspective.

The concepts related to this discipline are, among others: skills, professional situations, professional fields, awareness, and, especially relevant to our topic, pragmatic concepts.

The way in which Professional Didactics looks at practices is theoretically based on concepts used in the psycho-didactic approach to events and human behaviours put forward by Gérard Vergnaud [3], in particular with regard to analysing people's activities through the prism of the theory of conceptualisation in action.

3. Examples Illustrating PD Approach and Methods

A professional didactic analysis of an activity seeks to identify knowledge contained in practices and which is not immediately perceived. Examples will be given to illustrate PD's approach and methods, and to better understand its contribution.

3.1. "Bourrage" (Pastré, 2002)

In a factory that made plastic caps, the amount of misshapen caps was significantly lower when a particular employee worked the forge. A researcher was able to identify the reasons why this worker had better results than others, especially when a so-called "bourrage" ("filling") problem occurred. Why was it that an employee who worked on plastic at the exact same forge as others performed better than them? Pierre Pastré's research consisted in observing the work of that employee, who was acknowledged by his peers as the best worker in the company and commanded a lot of respect. The researcher went to see what he did in order to pass on his findings to the others and help maintain the company's turnover by improving all workers' performance. Thus, he observed, filmed, and conducted semi-structured interviews. He watched the worker's actions, recorded them, and when he was alone in his laboratory, in his role as researcher, he analysed what happened. However, he was still unable to understand why the worker achieved the results that he did. He therefore decided to conduct what he called a retrospective reflexive debriefing interview. In other words, he went back to ask the worker questions while the latter was working and talking him through what he

was doing. So there were actions and speaking about those actions at one and the same time. This is the first stage of Professional Didactics as it seeks to understand the activity of a professional: it tries to understand how they do the things they do. What do people actually do as they act?—that is the question that needs to be answered. The first principle of Professional Didactics states that, over and above the academic knowledge that people acquire at school or through professional training, they also develop and incorporate knowledge derived from their experiences. That is to say, in the course of their work, they acquire experience made up of knowledge, but they are not even aware that they have this knowledge. Thus, the goal of Professional Didactics is to understand what that knowledge is by developing relevant methods for researching, interacting, interrogating, and analysing what professionals do. Then there is the second stage of professional didactics: after trying to understand, it then tries to train and transmit. The new question that arises is what kinds of training can be devised? That is when the didactic dimension, stemming from the didactics of mathematics, is brought into play.

To understand the nature of the interaction between what the subject does and the situation it faces in this interaction, we need to go back a little earlier than Professional Didactics and turn to cognitive psychology.

Let us return to the "bourrage" example—the term the plastics factory workers used to identify the situation that posed them problems and to explain how, faced with a specific difficulty, a particular worker managed to find a better solution to overcome it than others. Pastré realised that the worker used his experience to mentally and practically conduct a mathematical operation; that is, the researcher was able to translate the worker's reasoning, what he mentally did to solve the problem, into a mathematical equation. The worker listened to the noise made by the forge and, by hearing it, he knew if he had to adjust or change the degree of pressure applied. If Pastré had merely observed or listened to what the worker said, it would have been impossible for him to know that the worker used his ears to establish his mathematical equation; the researcher also had to ask him questions in order to understand how he came up with the right solution and to follow his explanations while he demonstrated and explained. His operational invariant, in the psychological sense of something, a mental reasoning that allowed him to solve a problem, was based on what he heard. It was sensorial information reduced to reasoning—an invariant identified by means of a retrospective reflexive debriefing interview—that made it possible to find the solution. This is one of the research methods employed in professional didactics.

Developmental psychology and, more precisely, conceptualisation in action inspired by Piaget's ideas help interpret these observations. Jean Piaget was an epistemologist whose concern as a researcher was to understand how people go from knowledge level T to knowledge level T + 1. He identified the concept of cognitive conflict in children, but we know that adults too resolve cognitive conflicts in order to learn. Indeed, we always operate in the same way. According to Piaget, the concept of schema (schème) corresponds to this regularity. He defined a schema

as that which, in an individual's activity, can be repeated, generalised, and transposed from one situation to another. The concept of schema was later developed by his student Gérard Vergnaud, who spoke of conceptualisation in action. Vergnaud [4] related the reasoning identified by Piaget to the characteristics of the situations in which individuals find themselves and considered a new entity, the interaction "schema-situation", in order to emphasise the development of knowledge and people based on the characteristics of those situations.

So how do individuals develop their knowledge and skills, how do they themselves develop? The answer is, through conceptualisation in action. Conceptualisation in action is the ability to create new knowledge by acting and reflecting on those actions, looking for the most appropriate solutions to the problems raised by a situation. That is how a worker can have new knowledge, different from that of others, despite having undergone similar training. Gérard Vergnaud linked what an individual does, that is, the schema, to the characteristics of the situation in which they find themselves. But it is also what makes it possible to devise training, that is, to reflect on designing didactic situations that can foster the development of knowledge in individuals undergoing training. Thus, human activities, ours as well as those of children, are organised around schemas.

According to Vergnaud, a schema is a model of cognitive activity, an organised whole (a functional dynamic totality) steered by the subject's intention (the goal the subject sets out to achieve) and structured by the means used by the subject to achieve that goal.

In a more analytical definition, it is also a set of four interrelated components. A schema is therefore an invariant organisation of activity, for a given class of situations. The plastics worker had a specific schema of intervention. He could adapt, change the way his activity was organised. Therefore, he could adapt himself and his technical actions to all variations of that particular situation, such as the temperature affecting the viscosity of the plastic.

This schema organisation can be translated into the diagram in Figure 1.

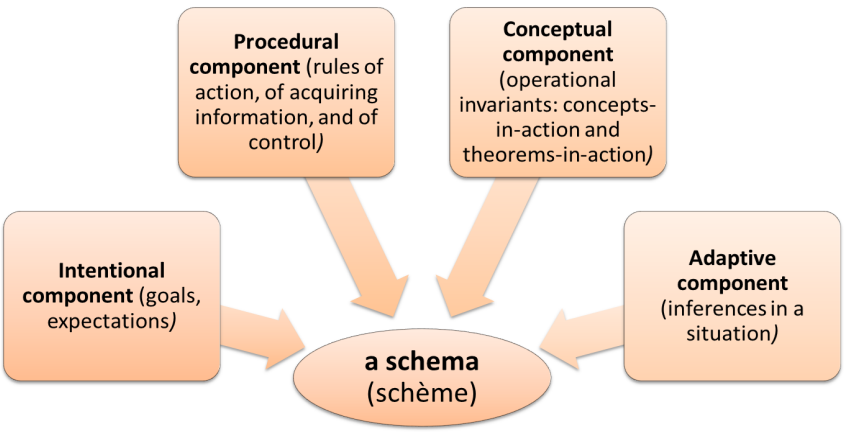

Figure 1. A schema is an invariant organisation of activity (according to Vergnaud).

Figure 1 explains how a schema (schème) is organised and, therefore, what we can do when we want to devise training. Either we focus on the goal of the action, trying to ask professionals questions in order to understand the reasons why they do something—this is the intentional component of a schema. Or we look into the rules they apply to perform their actions. For example, the worker told Pierre Pastré, "when I drop the plastic in the forge, I'm going to pay attention to what happens, the noise". It is when he said that that Pastré realised he used his ears to identify the problem. So he needed a certain level of quiet around him, despite the noise made by the forge, in order to be able to perceive any differences. It was thus clear that the conditions for his efficiency required certain particular characteristics, which allowed him to hear the noise of the forge and distinguish these variations. But the researcher could not have learned this if he had not conducted that interview in an attempt to understand and identify these rules of action. These rules of acquiring information by hearing were the procedural component, which the worker mobilised based on the third component of the schema, the conceptual component, that is, the knowledge and skills he had, which he used to act and to adapt to variations in the situation. In cognitive psychology this is known as operational invariants—that which enables reasoning and allows an individual to function, namely, the individual's knowledge and skills. So the worker knew some things, but when he took into account certain data pertaining to the situation he was dealing with, because of the rules for acquiring information, he was forced to link what he already knew to new, unforeseen realities, hence the inferences in that situation, which constitute the fourth component of the schema, the adaptive component: "I know this, but there is that in this situation, so I am forced to act in this way". The concept of schema provides a model of activity linked to a model of cognitive functioning. At the heart of the worker's actions lies conceptualisation.

3.2. Conceptualisation and the Pragmatic Concept

Conceptualisation means developing the intellectual means needed to gradually deal with increasingly complex situations. It does not always mean that the person who is learning will explain the reasons why they do things in a certain way. Concepts can only make sense through a great variety of situations. This definition is inspired by Vergnaud.

The pragmatic concept is an important concept of Professional Didactics. In the example of the worker, the "bourrage", the central core of the new knowledge that results from conceptualisation in action is the pragmatic concept. The pragmatic concept is a concept employed in professional didactics. It is what the worker used in order to solve the problem he encountered. It is what he developed in the course of the multiple experiences he had in the professional situations he encountered, and which the researcher identified by means of a retrospective reflexive debriefing interview and then passed on to others so they could be trained and the company's performance could be improved. It is what one looks for in the

best worker so it may be transmitted to others.

Conceptualisation organises and guides professionals' actions [5]. The pragmatic concept is constructed for and in action [6]. It has three characteristics: its function is to help diagnose a situation for efficient action; its nature is not implicit, but not entirely defined either (Vygotski's daily concept/scientific concept); and it is specific to a professional situation.

4. What Can PD Bring to the Balance of Biodiversity in Small Tropical Islands?

Thus, Professional Didactics seeks to use theoretical and epistemological ideas from cognitive psychology for the purposes of devising training. It therefore aims to understand human activity in order to train humans.

The concept of schema is a difficult one, but fundamental, in this author's opinion, in understanding what people do over and above what they say, what they do, and what they say about what they do. It is this aspect of human sciences in the development of biodiversity that is important to take into consideration, not only sociologically or theoretically, just by observing, but also with the aim of understanding by asking people questions about what they do, in order to subsequently organise the transmission of this knowledge through training. Hence the role played by professional didactics.

This adaptive capacity will also be of interest when changes occur in biodiversity, when developments in the situation emerge. What kind of coviability will we be able to organise? How will we manage to adapt and continue to live? The elements presented above can be found in this developing situation. What kind of coviability, what can we build to keep moving forward as we face environmental and societal changes from anthropy? We can draw on what we already know, the knowledge and skills contained in the practices of our elders, for example, taking them into account and then organising them based on new circumstances and situations faced by our society.

This is the point we will focus on. Fishermen and the values of fishing in Martinique are an example of this.

4.1. Fisherman's Fish Trap and the Values of Fishing

As we have seen, the professional didactic approach was used in the example from industry. The present author has used this method with youths training to become teachers and with young dropouts, with whom she has conducted a considerable amount of research [7]. The fishing example comes from ongoing research on sea and ocean professions, conducted partly in Martinique (https://line-numa-bocage.fr/). Indeed, during previous research conducted in 2016 on the use of games to learn mathematics, specifically the Awalé game [8], the author was amazed to find that, in 2016, young female secondary school pupils (Year 9) from Martinique did not know they were the descendants of slaves [9]. It occurred to her that there was a gap in education that needed to be filled in terms of passing on knowledge and

ancestral values. She thus focused on professions: what were the professions that were part of the local heritage and were in the process of disappearing, which, if appropriate training was devised, young people would be willing to go into and develop by adapting them to their twenty-first-century reality?

The author met young people, listened to them, and had conversations with them [10]. They are indeed ready to follow in the footsteps of their elders and practise these professions, provided they are adapted to their realities [11]; this includes sea and fishing professions, for example, which concern the islanders. That is why the author has sought and already started to meet with fishermen, who have specific fishing practices which need to be identified and understood so they may be transmitted. What have these fishermen done to ensure that, up until now, there has been a certain balance in biodiversity, despite the type of fishing they may do?

For example, what is the technique for building a fish net that is adapted to the size of sea wolf fish (anarhichas lupus) of farm in order to preserve them and pass on related values, all part of the bid to preserve ecosystems (i.e. with sea wolf fish that are small)? In this example, the focus is on the technique used to preserve the size of farmed sea wolf fish and pass on related values, all part of the bid to preserve ecosystems.

Another example relates to hole sizes, the techniques for setting up nets, and feeding in aquaculture on the Atlantic coast, where practices differ from those on the Caribbean coast.

By using self-confrontation to adapt the methodology of professional didactics, the author developed a specific type of interview: the self-confrontation interview for the purposes of professional didactics, or SCIPD [12]. SCIPD is conducted in two stages. First, there is a video-recorded semi-structured interview during which the professional acts and works, and then a second reflexive, retrospective interview in which watching the video recording helps clarify and explain the professional's actions. The aim is to update the knowledge and skills used in the actions performed and which are not conscious. In the aquaculture example, the initial, video-recorded self-confrontation interview showed two important things: 1) Feeding differed from one coast to the other because of currents, but it appeared that each fisherman had "his" own way of determining the direction of the current and his own feeding schema (schème). 2) The size of the nets varied with the age of the fry; the techniques for changing the nets were learned based on location, predators, and also the size of algae; different circumstances led to different net-changing rates from one coast to the other.

However, questions remained. How important was sargassum seaweed? "It's always been around" was the fisherman's reply. He seemed to know how to adapt. There has to be some specific know-how related to sargassum seaweed which hasn't yet been identified, with the underlying question being how to teach it to young people. The aquaculture example (https://line-numa-bocage.fr/recherches/) is the first stage in this ongoing research. The aquaculture approach is one area that al-

lows us to link ancestral practices to the technological and developmental changes we are currently experiencing, in order to train young people. There are issues, such as questions around dealing with sargassum seaweed, that deserve to be explored further.

4.2. Biodiversity in Small Islands

Biodiversity in small islands is a major development issue. Guadeloupe, which shares the same ecosystem as Martinique, illustrates the socio-economic dimensions affected by the concerns with preserving the environment and "coviability" (https://www.calameo.com/books/0056186675ce04c572851).

In a report by IFREMER (Institut français de recherche entièrement dédié à la connaissance de l'océan) [13], researchers show that professional fishing businesses in Guadeloupe are facing major structural and environmental challenges, but these businesses are an essential pillar of the local economy and food security. Targeted measures are needed to modernise the fishing industry, improve its efficiency, and strengthen its sustainability in the face of ecological, economic, and social constraints. The fishing fleet is aging, with a significant decrease in the number of vessels since 2000 (−45%). Most businesses are very small (VSB), often family-run, and have a low investment capacity. Revenues are heavily dependent on public subsidies and goods imported to supplement local production. Halieutic resources are in decline in inshore fishing, while deep-sea fisheries (pelagic fish) afford underexploited opportunities. Chlordecone pollution is one of the factors leading to the temporary closure of fishing zones. The report sets out clearly the structural challenges faced by fishing in Guadeloupe but provides few concrete solutions. Efforts will need to be made to help modernise the fleet and infrastructure, strengthen training to attract young people, structure the industry around direct distribution channels, and promote local products. The results of coviability processes together with understanding the fishing practices of VSBs as identified by using professional didactics methods for analysing professional activities could help improve production. Furthermore, aging fishermen and the professions' low attractivity among young generations are human science levers that can be judiciously used through tailored training in order to renew skills. An optimist outlook will depend on a collaborative management of marine resources, involving fishermen, institutions, and consumers. In order to tackle these challenges, the current project (2AI3D-EAPV https://line-numa-bocage.fr/recherches/) fosters collaboration between researchers and professionals from the fishing industry.

Another scientific study [14] report on recreational fishing in the French West Indies (Martinique, Guadeloupe, Saint-Martin, and Saint-Barthélemy) examines recreational sea fishing practices, their socio-economic impact, and user perceptions [15]. Recreational fishing is widely practised in these islands, there being a strong cultural attachment to it, but it is barely regulated, and its economic and environmental impact has not been adequately assessed. In 2022, there were 27,000 recreational fishermen in Guadeloupe, while 71% of fishermen have no-

ticed a diminution in halieutic resources. They are calling for stronger regulation and greater user awareness. One suggestion has been to better integrate recreational fishing into the management of halieutic resources and develop the sector's potential through ecotourism and better supervision. Understanding their practices and representations of the marine environment as identified by a PD analysis will help better tailor solutions for preserving the environment while promoting tourism.

4.3. J-A and Bagasse Processing: A Professional's Experience Is Greater Than Academic Knowledge (Inspired by Jacques Leplat)

In another professional activity related to agriculture and the harvesting of sugar in sugar cane, the author met a young man (J-A) who fed sugar cane into the crushing machine at a cane sugar mill. By conducting a self-confrontation interview for the purposes of Professional Didactics adapted to young people (SCIPD-Y) [16], it was possible to identify a specific technique for feeding the sugar cane into the crusher. This practice had been developed by this young man whose frail, sickly physique meant he could not rely solely on his physical strength to perform this action safely. It was specific to him, but it could be passed on to others once it had been analysed and integrated into specially devised training.

In this example, the method was a research tool, but also an element of training by identifying knowledge and skills used to perform the right actions.

5. Conclusions

The lecture will finish by focusing on the methodology that could accompany analyses conducted for the purpose of judiciously involving human actions in systems that foster the balance of biocenoses. It lays the basis for education and training tailored to the need for balanced diversity in our small islands' ecosystems. It could represent an important methodological and conceptual contribution made by Professional Didactics to the debate around biodiversity preservation involving populations' responsible actions.

Another example of ancestral practices worth reconsidering in this area is that of Amerindian practices as presented by Malcolm Ferdinand [17]. This example illustrates the ethnohistorical approach to the study of Amerindians' farming practices before the arrival of the colonisers. By taking a critical look at these, we can identify practices that respect the environment and nature in general. For instance, it would seem that the soil fertilisers used back then, such as crushed seashells, were made from ingredients that came from nature itself and were barely processed. Further analysis can yield information relevant to our current fertilisers. Malcom Ferdinand has concerned himself with agriculture and especially decolonial ecology. His ethnohistorical approach to the study of Amerindians' precolonial farming practices suggests one possible avenue.

"Coviability" and adaptation to environmental change are considered from

the perspective of ecosystem development. Our understanding of the cognitive behaviours of individuals (fishermen, tourists, youths), and the wider societal and environmental changes identified are in the process of being defined. The project seeks to provide conceptual, theoretical, educational, and pedagogical answers at the confluence of biological sciences and human and social sciences. To this end, there will be seminars and analysis-sharing between researchers from different academic fields, and results are being gradually uploaded on the site (https://line-numa-bocage.fr/recherches/). This ongoing research falls under the study of living organisms, combining a scientific approach to professional fishing practices in small islands with an analysis of these practices for the purposes of training based on an eco-developmental approach.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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