Welche Wege gehen die Methoden der Untersuchung im Internet in der didaktischen Forschung?

Caroline Ladage, Cécile Redondo

Aix Marseille Université

Zusammenfassung

Wir diskutieren das Interesse und die Schwierigkeiten der Forschungsmethoden bei der Nutzung des Internets als Forschungsgebiet und -infrastruktur. Der Untersuchungsansatz im Internet wird im Bereich der Didaktik getestet, um die Herausforderungen und Fallstricke zu identifizieren, mit denen der Forscher konfrontiert werden kann. Die anthropologische Theorie der Didaktik (ATD) wurde als theoretischer Rahmen verwendet, um die Untersuchungen für zwei Doktorarbeiten zu analysieren, die auf der Grundlage von im Internet gesammelten Daten durchgeführt wurde.

Quels chemins pour les méthodes de l'enquête sur Internet dans la recherche en didactique?

Résumé

Nous discutons l'intérêt et les difficultés des méthodes de recherche lors de l'utilisation d'Internet comme terrain et infrastructure de recherche. La démarche d'enquête sur Internet est mise à l'épreuve dans le domaine de la didactique pour identifier les défis et les pièges auxquels le chercheur peut être confronté. La théorie anthropologique de la didactique (TAD) a été utilisée comme cadre théorique pour étudier les enquêtes menées pour deux recherches doctorales basées sur une approche impliquant la collecte de données sur Internet. Les conditions, les contraintes et les points de vigilance lors de la réalisation d'une enquête sur Internet sont ensuite discutés.

Which methodological paths of inquiry on the Internet for research in didactics?

Abstract

We discuss the interest and difficulties of research methods when using the Internet as a research field and infrastructure. Our article presents an approach to investigating this particular use of the Internet that has been tested in the field of didactics to reflect on the challenges and pitfalls that the researcher may face. The anthropological theory of the didactic (ATD) was used as a theoretical framework to study the inquires carried out in two doctoral researches based on an approach involving the collection of data and materials on the Internet. The conditions, constraints and points of vigilance when conducting an Internet based inquiry are then discussed.

1 Introduction

Didactic research involves a wide variety of research approaches and data collection methods, commonly including interview or questionnaire surveys, documentary research, corpus analyses (of textbooks, student productions, etc.), observations, self-confrontation interviews, etc. It is impossible to identify precise standards for these methods, which means that didactic research is in line with the standards generally used in the humanities and social sciences. However, some research in the field of didactics proposes specific research techniques, in the way of mobilising existing techniques, or by producing new techniques, appropriate to the context being explored. These research projects provide opportunities to take paths that deviate from what is commonly expected, requiring sometimes difficult decisions to be taken and the development of solid explanatory discourses in order to explain the research process and the scientific value of the results it has produced. This type of approach can be observed in research that is part of the mainstream of the *anthropological theory of the didactic* (ATD) (Chevallard, 2007b; Bosch, Chevallard, Javier García, & Monaghan, 2019), one of the major objectives of which is the study of the conditions and constraints of the dissemination of knowledge and praxeologies[1] in a given society. What gives meaning to the adjective "anthropological" can be summarised as follows:

> "The anthropological principle affects the level of generality and specificity that is assigned to didactic phenomena. In the ATD, didactic phenomena are considered as inherent to any group of human beings, as part of humanity. Being human beings means co-creating and disseminating knowledge, and also failing to do so. Moreover, the anthropological approach also proposes a common vision of all kind of human exchange or activity, trying to exclude all kinds of value or categorisation brought about by the society and institutions researchers are immersed in—and subjected to." (Bosch et al., 2019, p. 8)

Many researchers have already contributed to the development of this theoretical approach: in addition to the work carried out in the didactics of mathematics education, which is at the origin of Chevallard's work, research has also been carried out in other fields of knowledge, such as museology, biology, languages, or on more cross-cutting issues such as *information search on the Internet* (ISI) or *education for sustainable development* (ESD). This opening, which is consistent with Chevallard's anthropological approach to didactics, called for an opening of the types of research methods in order to respond to the complexity of the study of the anthropological dimensions of the construction and dissemination of human knowledge and practices. What methods are used in an anthropological approach to didactics? What operations (techniques) are implemented to produce and disseminate knowledge in didactics? According to which founding principles to direct the path, decisions and choices made? In the framework of research in ATD as well as in the humanities and social sciences in general, the answers to these questions show the weight of persons and institutions in determining the

[1] It is important to note here that ATD uses the notion of praxeology in a particular sense in the context of a theory of human action whose starting point is the notion of a type of tasks, requiring the use of a technique (both of which form a human "praxis"). This technique requires an explanatory or supporting comment, which ATD calls its "technology". The technology is itself coupled with a justifying discourse at a higher level, which is the theory. Both levels of discourses form the "logos" of human activity. Analysing human activities as praxeologies allows the researcher in didactics to shed light on and better understand the nature of human knowledge.

representations of the objects under study. It is thus the principle of emancipation of the elements of the social world that is essential to implement in scientific work and for which different research methods have been developed and tested. What about research methods in didactics? We will not discuss here the research methods mentioned above, in order to focus on the development of computer sciences and the Internet, which have contributed over the last twenty years to an unprecedented enrichment of research practices and fields of study in didactics.

The question we are raising is "what is permitted to be known", and in particular today what is permitted to be known for the researcher in didactics thanks to the Internet. This question obviously concerns the current uses of information and communication within our contemporary societies, something which in itself raises many didactic questions, which we shall not go into here. It also concerns its scientific exploitation and the way in which the Internet can be used by researchers as a research field and as a research tool, which is what we are questioning here more particularly in didactics in an anthropological approach. In this sense, everything Internet hosts can be of interest for the researcher in didactics who aims to assess for example the nature and degree of dissemination of a given phenomenon, or the existing (or absence of) culture(s) on a given subject matter. It is useful here to mention the general aim of didactics by referring to one of its definitions within the ATD:

> "Didactics is defined as the science—still in infancy—whose object is to study the conditions and constraints that govern the dissemination of praxeologies in institutions across society. Dissemination is taken here in an extended sense: it also includes non-dissemination and the most notably deliberate withholding of praxeologies concerning specific institutions." (Bosch et al., 2019, p. 27)

Chevallard considers that one of the fundamental reasons for the existence of ATD is the problem of the epistemological and institutional emancipation of the position of the didactician and of the didactic science he produces vis-à-vis the institutions that serve as habitat for his objects of study (2007b, p. 705). The initial purpose of ATD was therefore to free the study of school-based teaching and learning of mathematics from the subjection to the codes of the School. The scope of Chevallard's research quickly extended to any other field of knowledge and praxeologies and the persons and institutions that produce and use them.

In this article, we start in the first section by briefly analysing the extraordinary infrastructure the Internet offers to access information produced by persons and institutions from multiple perspectives. We then present a short overview of some main methodological principles in ATD used as strategies to put into practice the emancipatory principle. In the third section the research framework of the ATD will be discussed in the light of a selection of practical research tasks and research techniques used in two doctoral research projects. We analyse if and how the theoretical discourses, that describe, explain, and justify the work of researchers, needed adjustments to be used effectively. In doing so we then aim in the fourth section to point out the difficulties that the researcher faces to use the Internet as a research infrastructure.

Our contribution is based on effectively completed and published research, in order to highlight several methodological dimensions that were important for these studies, but which were not fully clarified in the original publication. We present some of these most salient operations, in order to establish an assessment of the choices made, without aiming at exhaustiveness.

2 Internet as a field and research tool

In didactics, in educational sciences and in the humanities and social sciences in general, the Internet has become a major object as well as a research tool. In the variety of inquiry methods for which the Internet can serve as a tool, we focus our analysis on the research by inquiry and its processes, starting from the observation that many inquiry techniques can be carried out *on* and *with* the Internet. Today's researchers investigate *on* the Internet in order to document their research, working in fields of study for which the Internet can offer extraordinary sources of observation of human activity according to a diversity of methods, including experimental ones. They can also investigate *with* the Internet, either by finding materials for literature reviews or scientific monitoring, or by disseminating their own surveys by questionnaire to remote populations. At times a space for investigation (*on*), at times a tool (*with*), the Internet is of interest to research in educational sciences in more than one way.

As a research object or field, inquiries on the Internet have been for over a decade an integral part of the work of a large number of disciplines that study human behaviour (Illingworth, 2001; Jones, 1999; Coleman, 2010), most often by mobilising their specific research methods, but also by developing shareable methods adapted to the observation of human activity on the Internet, in particular for data collection, at a small as well as a large scale (Boyd & Crawford,2012).

From the point of view of research methods and tools, the Internet constitutes an infrastructure that hosts numerous virtual spaces, thus offering the researcher the possibility of a multiplicity of types of data collection in all digital formats (text, image, sound, video), including elements that are not directly visible on the screen (statistical data of traces of human activity on the Internet systematically recorded on the servers that host the web). The development of digital ethnography, also known as virtual or online ethnography (netnography), which adapts ethnographic methods to explore the internet as a socially constructed but technologically mediated landscape (Hine, 2017), illustrates the importance of the question of appropriate research methods (Caliandro, 2018).

Research in line with the anthropological approach to the didactic as a theoretical framework, not only relies massively on all the diversity of resources available on the Internet, representing as they do human activities, but also on the diversity of existing or still to develop methods in human sciences.

To illustrate the conditions of use of the Internet as a research infrastructure in a didactical approach, we propose to highlight excerpts from the paths that were followed in two research projects conducted in the framework of the ATD to produce knowledge on the issue of the dissemination of knowledge in society. Both are doctoral dissertations, the first was conducted in 2008 and investigated the praxeologies of information search on the Internet (Ladage, 2008). The research studied the conditions and constraints determining institutional and personal Web search "praxeological equipments". The questions the research addressed are threefold. Firstly, which praxeologies can be regarded as useful to Web search? Secondly, what is the offer of praxeologies in this field? Finally, what are the obstacles which limit access to a large supply of appropriate praxeologies?

The second investigated the epistemological foundations of pedagogies within the framework of education for sustainable development (Redondo, 2018). We hypothesize that a fragility of knowledge at the didactic and pedagogical levels influences the quality of dissemination and that of the praxeologies involved. In both cases, the research relied mainly on the

Internet as a field for data collection to study the dissemination of knowledge in these two fields by replicating ATD's methodological paths.

3 A short overview of the ATD inquiry-based research framework

In ATD research, whose researcher's epistemology and praxeologies we propose to question, the inquiry approach is central. In addition to the two doctoral dissertations we have just cited, we find this approach in various research works by Yves Chevallard (for example Chevallard, 2011; Chevallard & Ladage, 2010), as well as in the doctoral thesis by Sinae Kim (2015). The epistemological foundations of these inquiries are multiple. As a true act of citizenship, the inquiry process is considered in an anthropological (Ladage & Chevallard, 2011), logical (Dewey, 1938, 2013), historical and epistemological perspective (Ladage, 2017). The production of knowledge (for oneself or for a community) is the first objective of the inquiry process. However, it finds a more accurate formulation in the idea that it is not always so much a question of producing knowledge as one of questioning existing knowledge and praxeologies, in other words, questioning the world. Most inquiries lead from the identification of inquiry questions to the production of answers of which at least a part can be considered as new knowledge. But it can also happen that no answer can be solidly constructed, leading the process of inquiry to the assessment of an absent or only partially admissible answer. For this reason, ADT emphasizes that the answers constructed during the inquiry process are always partial and provisional. As with any research result, the outcome of an inquiry is considered provisional and, by definition, incomplete (Becker, 2017). This also raises the question of what can be described as "science", in the sense that Stengers highlighted as the problem of the absence of a "demarcation criterion" that would make it possible "to decide whether or not an approach is scientific" (Stengers, 1997, p. 17).

The inquiry approach at the heart of scientific research does not meet previously agreed standards, which can undermine its credibility with regard to other scientific approaches. It may require the implementation of techniques decided upon in relation to the questions being studied and sometimes even be constructed ex nihilo when existing research and data collection methods are not satisfactory. To provide a framework for the questioning process, whatever the didactic context (scientific, but also pedagogical), Chevallard has identified a series of dialectics of inquiry that structure it and whose mastery determines the quality of its progress. It is not, therefore, an attestation of conformity to the path to be followed, according to rules validating the approach. The inquiry process is open-ended here, as defined by Ladage (forthcoming) on the basis of the paradigm of questioning the world described by Chevallard (2011). The selections of dialectics we describe in section three are as many invitations to question and clarify the path of the inquiry conducted, as they are landmarks to account for it (or not) in scientific productions. The inquiry thus defined includes a pragmatic aim and as an act of citizenship can be implemented in many contexts (Ladage, 2017). In didactics, in addition to its place at the heart of its research methods, it is also its use in the classroom that we are studying in the framework of an inquiry-based pedagogy to encourage its use as an act of citizenship (Chevallard & Ladage, 2010a, 2010b; Ladage & Chevallard, 2011).

There is however a difficulty with the implementation of the approach and the means of reporting on it in research work (but this applies to many inquiry-based approaches). Indeed, it is important to note that the presentation of the results of a research inquiry of this type poses a major problem in terms of the restitution and communication of the path taken

and the results obtained. A research report is often long, based on a collection of mostly heterogeneous data and does not follow standardised norms of scientific production and communication. It is not surprising, then, that the scientific productions that report the paths taken by this type of inquiry favor forms such as books, theses, summary notes or research reports. This is indeed the case of the two doctoral research projects that we take as an example in this article to illustrate the particular paths taken during the inquiries carried out.

In the following two sections, we first retrace these paths of our investigations in the light of the methodological research framework of the dialectics as analysed by the ATD. We then present examples of the conditions under which the Internet inquiries undertaken as part of these two doctoral researches were carried out and which required vigilance that led to decisions that went beyond the initial framework.

4 Dialectics at work in an inquiry for research in didactics

The type of inquiry we conducted in the two doctoral research projects we are discussing in this paper follows an open-ended inquiry pattern and is based on an approach involving the gathering of data and materials intended to produce an answer to a given question (Ladage, 2008, 2017; Ladage & Chevallard, 2011). The notion of open-ended and unlimited inquiry (Ladage, forthcoming) is justified here by the multiplicity of techniques potentially required during the course of the inquiry and by the diversity of the types of data possibly collected to constitute an unlimited corpus, since, a priori, the path of the inquiry (Peirce, 1931) is not known. As we have seen, in this case, in order to construct a corpus of data from the Internet, the central object of the study is not a defined population of individuals or institutions and their productions or traces on the Internet, but a population with indistinct contours, insofar as the approach is based on the data to which the inquiry has led the researcher. In their relationship with knowledge, researchers are in fact most often led to make decisions and choices between elements that may sometimes appear contrary, useless, too distant, etc. The corpus of *exposés* that we have cited so far on the subject of the two dissertations are, moreover, far from being the only material collected for this research. The question now is to try to understand these dilemmas and questions that have emerged in the course of these two inquiries. However, as we have seen, one of the most remarkable characteristics of an open inquiry is its length and the richness of its materials, which require adapted forms of publication such as a thesis, book or research report, and it is therefore impossible to describe them with precision here.[2]

The choice has therefore been made in the following part of this article to present a selection of dialectics which the ATD considers as ways of thinking and acting, most often requiring the overcoming of antinomies of different types. These are the dialectics of inquiry, which are "dialectics of study and research" (Chevallard, 2001; 2007a). By “dialectic” ATD means “Any praxeology that enables one to overcome two opposed types of constraints by

[2] As an example, in Ladage’s dissertation, see the inquiry report explaining the details of the path and the techniques mobilised on more than 100 pages in a inquiry that questioned the research methods and conclusions of the book published in 2007 by Barbara Cassin, *Google-moi. La deuxième mission de l’Amérique* (Ladage, 2008, pp. 88-209).

turning them into a new kind of conditions that supersede them. In this context, one, therefore, speaks of supersession (French *dépassement*, German *Aufhebung*, Spanish *superación*)".[3]

We present below six dialectics of inquiry to illustrate the principles in tension at different points in the inquiries we have undertaken: namely the dialectics of on-topic and off-topic, of the parachutist and the truffle hound, of black boxes and clear boxes, of conjecture and proof, of reading (or "excribing") and writing (or inscribing), of dissemination and reception. These are not steps in a linear work, we have mobilised them throughout our inquiries and often in an overlapping way. For lack of space, we illustrate them where the example lends itself to a concise presentation by focusing on research on the ISI's praxeologies, since the dialectics of inquiry into ESD praxeologies are in many ways similar.

4.1 Dialectic of on-topic and off-topic

This first dialectic, which questions what is relevant to the inquiry being conducted, is a general and central question in the researcher's work:

> "At school, the course followed by an inquiry is traditionally supposed to remain on-topic all the time, without wandering off-topic even for a short detour that would seem promising in terms of unexpected but hopefully relevant encounters. Proper mastery of the dialectic of on-topic and off-topic makes it possible to overcome this institutional limitation and go away at times from the apparent right path, in search of the unforeseen." (Bosch et al., 2019, pp. 22-23)

This dialectic has been particularly present in research on ISI practices when we conducted a study on knowledge useful to the ISI. We identified – without claiming to be exhaustive –multiple praxeological fields (computer science, law, economics, mathematics, physics, history of science and technology, political science, etc.), which probably few experts can claim to be equally familiar with. Our exploration has sent us back on the paths of a host of old and newer, even emerging disciplines. The complexity of the Internet has thus revealed itself to us and has demanded open epistemological attention and in-depth inquiries in praxeological fields apparently far from the Internet world, at the risk of being off-topic. This complexity has brought us into contact with other dialectics that we discuss below and has led us to introduce the idea of a "praxeological border" (Ladage, 2008, p. 268) between what is useful to know for a given person or institution and what will be considered not very useful, or perhaps even too difficult to effectively master.

4.2 Dialectic of the parachutist and the truffle hound

Intimately linked to the previous one, this dialectic questions both the praxeological fields and the spaces (real or virtual) operating as media for the sought-after information.

> "When looking for information in the course of some inquiry, one has to sweep vast areas, thus acting as a (military) parachutist, while knowing that the information searched for will be found (in the way a truffle hound—or hog, or pig—does) only in

[3] In the following section all the citations come from the glossary of the book already cited "Working with the Anthropological Theory of the Didactic in Mathematics Education" by Bosch, Chevallard, Javier García and Monaghan (2019).

> some sporadic, unexpected places. The capacity to do so is identical with the mastery of the dialectic of the parachutist and the truffle hound." (Bosch et al., 2019, p. 24)

When it comes to collecting data on the Internet in an open-ended inquiry, it is most often a question of data spotted through a variety of inquiry actions leading to the constitution of a potentially unlimited corpus, since, a priori, the path is not pre-established but adapts as progress is made. Identifying knowledge useful to ISI also required ISI knowledge from the researcher herself. Thus, it was particularly important to master and deepen these techniques by accepting to push back our own praxeological boundaries to avoid the subjectivity bias mentioned above. "The exploration of the whole that is hidden in an often ephemeral action brings to light what is happening, as we say in English, behind the scenes; or, according to an opposition taken from Bachelard, plunges us into the noumenology of Web search." (Ladage, 2008, p. 438). This principle has led us to face many dilemmas of yet another kind: how far to check the intelligibility of the phenomena encountered.

4.3 Dialectic of black boxes and clear boxes

The identification of ISI praxeologies and knowledge useful to ISI also required verification of the level of comprehensibility of the selected elements. To this end, we carried out in-depth inquiries, sometimes even new inquiries, which initially were not directly related to the question at hand, but which appeared necessary on the path to the inquiry, either because of a lack of knowledge on the part of the inquirer, or because of the need to clarify certain elements of the inquiry. Here again, the idea of an epistemological boundary appeared to be a useful one for delimiting work, drawing boundaries or, on the contrary, pushing them back. The question of the praxeological boundary also applied to ourselves: some knowledge useful to the ISI proved too difficult for us to become proficient in, leading us to give up this or that path of our inquiry (for example, we left the algorithms of some search engines in the black box), thus managing the dialectic of black boxes and clear boxes:

> "Praxeology that allows one, when confronted to some praxeological element, to manage one's way between full ignorance (black box) and supposedly complete knowledge (clear or white box) of that element. To cast it in formulaic style: this dialectic helps one determine the right 'shade of grey' to work with— there is no such thing as a purely 'white' box." (Bosch et al., 2019, p. 22)

In the work of the researcher in didactics it is essential to break with the primacy given to the knowledge already available for a given praxeological field. The aim of the conducted inquiry was to give priority to the primacy of relevant knowledge, whatever its status with regard to institutionally established knowledge, while carrying out the work of clarification in the best possible way in order to have a solid epistemological control. It was obviously impossible to understand everything at our level (this being a matter of collectives, societies and civilizations...), but it was also a question of tracking down the aspects of reality that were not visible (boxes that are invisible because they are transparent) in order to deconstruct the evidence of the culture of the institution being studied (or of the researcher) whenever this seemed useful.

4.4 Dialectic of conjecture and proof (or dialectic of media and milieus)

This dialectic is one for which the Internet provides the most extraordinary infrastructure, allowing the researcher to confront almost any given statement to multiple milieus, neutral regarding the questions at stake.

> "In the course of an inquiry on a question […] [the researcher] is confronted with statements expressed by what is generically called media, a medium being any system that issues messages—a textbook, a teacher, a newspaper, the Internet are all media. […] Notwithstanding their plausibility, mostly all the statements […] should be regarded as conjectures, i.e. as statements based on incomplete evidence. Looking for evidence is thus the sinews of inquiry. Proof of a statement should be looked for by questioning media which, with respect to this statement, behave like 'adidactic' milieus. Such an adidactic milieu—or simply milieu, if no ambiguity is to be feared—is a system deemed to be devoid of any intention to prove or disprove [the statement], much like a part of the inanimate world. The dialectic of media and milieus enables the pursuit of truth—even in cases where there is no decisive test." (Bosch et al., 2019, p. 22)

This questioning therefore goes well beyond the simple verification of the reliability of an *exposé*, about which the researcher deepens his knowledge of the context in which it was elaborated. The use of the Internet as a milieu was particularly useful to us when we were confronted with the assertions on Google that we had spotted in Barbara Cassin's book *Google-moi. La deuxième mission de l'Amérique* (*Google me. America's Second Mission*) published one year before the defense of our dissertation. We came across this book in our inquiry into the ISI praxeologies and decided to consider the book as part of the *exposés* of our corpus. We decided to conduct a kind of counter-inquiry in order to question the author's representation of the Google search engine. Without being able to go into the details of our counter-inquiry here, whose account covers over a hundred pages, we retain a key moment in which we were able to make the search engine itself work as a milieu for shedding light on the fact that the author's assertions failed to take into account the socio-economic context of the company. To make a long story (inquiry) short: we found inadequate Cassin's interpretation of the notion of "mission statement", which she had spotted in the company's official speeches and in which she read an arrogance and an all-powerful willingness of Google, when it states that "Our mission is to organize all the information in the world". In view of the authors that Cassin used to support her inquiry (notably the philosopher Heidegger and the philologist Klemperer), we decided to investigate the societal context of Google. We found that the Web was full of examples of mission statements of all kinds. The simple sample we were able to build up suggested that the phrase "our mission is", and the very fact of talking about a mission, are commonplace in the English-speaking world.

4.5 Dialectic of reading (or "excribing") and writing (or inscribing)

The example of Cassin's work underlines the fact that most of the information we can access is found in texts (whether in written or spoken form). The dialectic of textual excription and textual inscription alerts us to the fact that:

> "Texts are made of assertions that both follow from and manifest praxeologies which, usually, remain hidden to the casual reader. These praxeologies have been "inscribed" (and thus concealed) in the text, so to speak; conversely, the serious reader, who feels concerned with the praxeologies put to use to produce the assertions he reads, will have

> to ‘undo’ the inscribing by—to use a neologism—‘excribing’ them, i.e. by questioning the text about its hidden content, so as to bring to the fore normally latent praxeologies. It follows from all this that, reciprocally, in producing […] [an answer to a question, one] has to devote much effort to ‘inscribing’ it into the text that will preserve it from oblivion and make it known more widely. Altogether, all this necessitates considerable writing and above all different kinds of writing (such as in a notebook, a progress report, a draft, etc.).” (Bosch et al., 2019, p. 23)

The exploration of ISI praxeologies included any kind of *exposé* on the ISI, and of course, in addition to works with philosophical questioning, also works by experts on the subject, whose objective of a didactic approach to the ISI was obvious. The difficulty we faced at that time was to construct a technique to highlight what the text proposes, but also what it does not propose. Faced with an *exposé* we therefore considered that two approaches were possible. The first consists in listening to it, in trying to hear what it consists of. But it has the disadvantage of erasing what the *exposé* does not say, when it could say it. A second attitude then consists, not in letting the text speak, but in questioning it to see if it answers this or that question. An excriptive reading of two chapters of the book led to the identification of a total of 388 questions. 321 questions for the “*How to search*” chapter (in the 2006 book *Web Dragons* by Ian H. Witten, Marco Gori and Teresa Numerico) and 67 questions from Greg R. Notess’s 2006 book *Teaching Web Search Skills*. We had thus literally built up a database of questions that arise in the ISI’s praxologies, but the difficulty remained in reporting on them, which leads us to the last dialectic we have chosen to illustrate.

4.6 Dialectic of dissemination and reception

Throughout our inquiry process, we noted in a journal the questions raised, the queries made on search engines (keywords and expressions) and the hypertext links (URLs) of the materials found. The materials were recorded in order to be able to consult them during the inquiry at any time, during and after the inquiry. However, the scope of the inquiry with its multiple ramifications posed us important problems of restitution of the work vis-à-vis third parties (research team, communications, publications, teaching, the final writing of the doctoral thesis). We have therefore become fully aware of the difficulty of reporting this type of inquiry to the scientific community by retaining the importance that whatever the issue of an inquiry, be sure that it will disseminate outside of the researcher’s workshop.

> “Bringing an answer to a question is a social act, the product of which cannot be restricted to a single place—‘leaks’ are sure to happen. The dissemination that takes place alters the ecology of […] [the result of an inquiry] and may, therefore, diminish its viability […]. How […] [this result] will be received is thus a crucial concern for its producers and potential users. The dialectic of dissemination and reception is, therefore, a key tool of inquiry.” (Bosch et al., 2019, p. 22)

Researchers generally derive the legitimacy of their choices from the scientific rigor they place in their modes of reasoning and in the techniques they use. It is therefore important to explain as precisely as possible the conditions under which the inquiry is carried out at the different stages of writing the results in order to present them in a diversity of scientific productions. The difficulty in this respect lies in the scarcity in the educational sciences of the types of scientific production suited for narrating open-ended inquiries, such as we have just sketched out a few outlines and paths.

5 Conditions, constraints and points of vigilance when conducting an Internet inquiry

During the inquiries carried out on the Internet during the two doctoral research studies, we identified four issues that required particular vigilance.

5.1 Consistency of the theoretical research framework for introducing new research techniques

Firstly, as in the case of other fields and/or other objects of inquiry, it was necessary to ensure the coherence of the theoretical frame of reference in didactics for the consideration and explanation of the type of data collection and analysis based on those available on the Internet. In fact, if since the development of the Internet in the 1990s, the wealth of resources reveals a richness that is difficult to estimate, this should not, on the other hand, conceal the shortcomings, the nature, and outlines of which it is up to the researcher to identify. Thus, in order to answer this or that question, the inquiry may reveal documents (or data in the broadest sense) available on the Internet, while potentially also revealing documents that are absent or with reduced access. It is therefore important here to work from the idea developed in didactics, that what is being studied is what is "permitted to know", as mentioned above. In order to bring this phenomenon to light, we have been led to develop a research methodology that can testify to the degree of possible contact with the data being sought on the Internet in response to a given question. In a way, it was a question of investigating the Internet on the state of the available culture by going beyond the usual techniques for finding information in a search engine, which did not provide satisfactory answers to our inquiry questions. The "witness technique" being new, it was necessary to describe in detail every single step taken to carry it out, at the risk of discouraging the reader (Ladage, 2008, pp. 528-547). With hindsight, we can say that although the technique did produce very interesting results, the opportunity to replicate it was extremely rare because of its complexity.

5.2 The difficulty of naming the objects of the research properly

Secondly, the nature of the data sample that can be constructed from the Internet has particularities that need to be accounted for. The collection can concern data of all kinds that are more or less precise and more or less extensive expressions of human activities, more or less remote in time, and whose composition, conditions and constraints on the persons and institutions that are at the origin of these activities (in other words, their social ecology) are to be studied. Only productions and traces of human activity appear on the Internet. It is therefore impossible to work on exhaustive data – only partial observations can be made.

The choice of our two investigations was to rely on the study of human activities described, in a more or less explicit way, in texts and productions of any type, available on the Internet. A sub-population of activities present – in one way or another – in the set of texts was constituted. These texts have authors, known or anonymous, who have worked in a given context. The Internet thus offers to read, to see and to hear a substantial part of personal and institutional activities, even the most singular, thanks to the fact that they have been made public in one form or another. It is therefore necessary, thanks to the production of these

texts, to observe these persons and if possible, the institutions in which the texts were produced. The literature (Landers, Brusso, Cavanaugh & Collmus, 2016) insists on the fact that since the data collected on the Internet are behavioural, it is important that the analysis consider the situation and the interaction that gave rise to the production of these data. The search for such information on the contexts in which the texts of interest to us were produced proved to be difficult and most often led to a collection of incomplete information, which we nevertheless wanted to consider as useful material for our inquiries.

In the context of the research on Internet search praxeologies, our aim was first to overcome the difficulty of naming and qualifying these heterogeneous productions as texts, which led us to propose the notion of the French word "*exposé*"[4]. Thus, an *exposé* refers to any organized totality - of whatever nature, generally open-ended - of written statements, here in electronic form, about the object of interest to us, in other words "any text claiming to give knowledge of something" (Ladage, 2008, p. 217) about the object at the heart of the work. In this way we will carefully consider everything that is said (or rather written) about the praxeological field under study. The heterogeneous nature of the *exposés* – from the point of view of the usual cultural criteria – is also emphasized: "an *exposé*, therefore, may consist of all or part of a paper (published in a mainstream journal), a dissertation (master's thesis, doctoral thesis, etc.), an article (in a magazine, scientific journal, etc.), a book, a treatise, a collection, etc." (Ladage, 2008, p. 217). This method allows us, through "oblique and not frontal observations" (Ladage, 2008, p. 69) (as opposed to statements collected for example through a questionnaire or an interview) to probe what the *exposé* - taken as a whole, provisionally stopped at a given moment - can spontaneously reveal. The use of the single term "*exposé*" has proved to be very useful to free oneself from the limitations imposed by the multiplicity of notions available in mainstream culture to designate human productions on the Internet. It has been replicated in our research on ESD praxeologies (Redondo, 2018).

5.3 The relativity of the requirement of reliability and representativity of the "exposés"

Thirdly, faced with a corpus of *exposés* of this type, it was then necessary to answer the (recurrent) question of a possible lack of reliability of the data collected on the Internet, even though this criterion of scientificity falls within the competence of the researcher who builds this reliability (through their process of problematisation, theoretical framework and methods). In this perspective, Internet resources were explicitly placed in their context of study, as a reliable medium not in itself, but in relation to the inquiry carried out, a question to which we will return later on the subject of the dialectic of media and milieus.

In the same vein, as in other fields of investigation, the constitution of a corpus of data does not allow for undue generalization of the observed behaviours. Internet users as a population cannot be stated to be fully representative of the entire population under consideration because many groups may be excluded from the scope of observation, including at a global level. Data are not always accessible to researchers, which threatens the internal validity of research and limits its scope. The collection of data on the Internet therefore inherently carries a risk of sampling bias, which requires a theoretical frame of reference capable of justifying the choices made. It is therefore particularly important in the process of an open inquiry

[4] Given the difficulty of a proper translation of this term we decided to keep the French word "exposé". The closest translation would be "an account", "a report", "a presentation" of any kind.

to reveal, explain and argue the path of questioning and the way in which the inquiry material was collected.

5.4 Criteria for the constitution of the corpus of exposés

Fourthly, we had to respond to the fact that the constitution by the researcher of a corpus of data on the Internet can be considered entirely personal and subjective (influenced by their own knowledge of the subject and their Internet search techniques). In the context of the dissertation on ESD (Redondo, 2018), we enriched the 2008 approach to include the constitution of a corpus of heterogeneous *exposés*, with the idea of organizing the search for *exposés* by other persons in order to objectify their choices. With reference to the technique of witnesses, the questioning thus focuses on what a person (or a collective) can "access" when gathering materials on the Internet.

Our witnesses were a class of 146 third-year undergraduate students in educational sciences from the University of Aix-Marseille. Each of them had to search the Internet for five presentations on didactic situations that were more or less explicitly described (on web pages, teachers' blogs, etc.) or through literal documents (excerpts from textbooks, teaching guides, etc.). The collective quest led to the constitution of a sample of 780 ESD-related *exposés*, according to conditions that we do not know, except that these *exposés* were found by students who aim at being teachers, and who potentially in the near future could be looking for such documentation to enrich their ESD praxis. We thus justify our method of data collection by this theoretical perspective based on the question of "what is permitted to know" in the current state of the culture on the subject, accessible via the Internet. The corpus of presentations made by the students thus serves as a medium devoid of intention towards us, to which we will also come back on the subject of the dialectic of media and milieus.

From the first sample of 780 *exposés* (spontaneous and non-representative) describing didactic situations, testifying to a certain diversity and richness of situations (actual or projected) and teaching practices (existing or potential) of the moment, a sample of 501 *exposés* could be exploited. The 224 *exposés* that were removed from the spontaneous sample, were duplicates and invalid situations, according to the instructions given to the students. Faced with the large quantity of documents retained, various difficulties emerged: those of describing and analysing often voluminous and heterogeneous sets of texts; that of identifying the elements representative of our theoretical categories, in complex presentations that mentioned several categorical types where we had planned to identify only one or two elements per category. This was particularly the case for the pedagogical types and the organizing frameworks of these activities, which sometimes turned out to be relatively numerous and intertwined. Our method then consisted in referencing between the pedagogical technique and the organizing framework, the one that quantitatively predominated in the text, to the detriment of others that appeared nevertheless within the presentation on the same didactic situation. What we could not do due to lack of time was the multidimensional analysis of the *exposés*, which would have required, for example, the construction of a database using ad hoc software. What also could not be done was to verify in detail the degree of possible contact with these *exposés* according to the keywords and search strategies of each student, following the example of the witness technique developed for the research carried out in 2008 on the accessibility of answers to ISI questions. This level of depth in the student survey was too complex to implement with 146 witnesses.

6 Conclusion

In this article our objective was to describe our research in didactics based on the method of inquiry. This explicit reflection on the method, which is intended to be a synthesis reflection, a general recapitulation of the approach followed (Stryckman, 2016), sets out the principles established, but also discusses the options and choices that were possible, the accommodations, adjustments and negotiations, in relation to the reality of the field, here the Internet. We have thus sought to characterize the transition from the theoretical (abstract) to the empirical (concrete) by attempting to clarify the founding principles and norms governing the choices made, while illustrating them with examples from two doctoral research projects. This methodological reflection operates in an epistemological context of which we have outlined a selection of theorizations, and which still deserve to be developed. This theoretical basis is an intrinsic part of the relevance and reliability of the path we have followed, as well as of the epistemological value of the obtained results.

According to what we have tried to show, the survey is based on a variety of pathways. We have therefore seen that it is not one approach but a range of approaches that have proved necessary to adapt to the constraints imposed by the object of research and its empirical treatment.

As in other fields of the educational sciences, the Internet inquiry approach can be deductive or inductive, quantitative, or qualitative, as it can also combine these possibilities according to its purpose. It is based on a collection of information that is most often already available, leading to discussions on how the corpus of data ultimately constructed can be considered sufficiently reliable to document the questions and hypotheses that are formulated (Becker, 2017).

Inquiry on and with the Internet constitutes an undeniable enrichment of the investigation possibilities for the discipline, both in terms of its objects and methods. To open inquiry, the Internet offers an unprecedented research infrastructure researchers must become familiar with in order to use and share inquiry techniques and pathways. The objective of open inquiry is the construction of new knowledge for research, but sometimes new only to the researcher who may need to approach knowledge for which few or no resources exist. During an inquiry, a wealth of knowledge is mobilised, part of which is specific to the question being studied, to the field of practice in which the question is relevant, and another part, just as essential for research, is the tool mobilised to produce new knowledge. The legitimacy of the open inquiry approach is susceptible to various attacks in terms of the nature of the data used as material and the singular character of the approach. The complexity of the Internet and the phenomena that are developing there call for the diversification and experimentation of new methods of research and data collection in the educational sciences, requiring scientific rigor and technicality, but also a significant amount of creativity.

References

Becker, H.S. (2017). *Evidence*. Chicago: The University of Chicago Press.

Bosch, M., Chevallard, Y., Javier García, F., & Monaghan, J. (2019). An invitation to the anthropological theory of the didactic. In M. Bosch, Y. Chevallard, F. Javier García & J. Monaghan (Eds), *Working with the Anthropological Theory of the Didactic in Mathematics Education*. London: Routledge.

Boyd, D. & Crawford, K. (2012). Critical questions for big data, Provocations for a cultural, technological, and scholarly phenomenon. *Information, Communication & Society*, 15:5, 662-679, DOI: 10.1080/1369118X.2012.678878

Caliandro, A. (2018). Digital Methods for Ethnography: Analytical Concepts for Ethnographers Exploring Social Media Environments. *Journal of Contemporary Ethnography*, 47(5), 551–578. https://doi.org/10.1177/0891241617702960

Chevallard, Y. (2001). Les TPE comme problème didactique, *Séminaire national de didactique des mathématiques*. http://yves.chevallard.free.fr/spip/spip/IMG/pdf/YC_2001_-_Seminaire_national.pdf

Chevallard, Y. (2007a). Un concept en émergence : La dialectique des médias et des milieux. *Séminaire national de didactique des mathématiques*. http://yves.chevallard.free.fr/spip/spip/IMG/pdf/YC_-_Sem_nat_DDM_-_23_mars_2007.pdf

Chevallard, Y. (2007b). Passé et présent de la théorie anthropologique du didactique. In L. Ruiz-Higueras, A. Estepa, F. Javier García (ed.), *Sociedad, Escuela y Mathemáticas. Aportaciones de la Teoría Antropológica de la Didáctico*, Universidad de Jaén, 705-746. http://yves.chevallard.free.fr/spip/spip/IMG/pdf/Passe_et_present_de_la_TAD-2.pdf

Chevallard, Y. (2011). *Didactique fondamentale*. Module 1 : Leçons de didactique. Aix-Marseille Université I. http://yves.chevallard.free.fr/spip/spip/IMG/pdf/DFM_2011-2012_Module_1_LD_.pdf

Chevallard, Y. & Ladage, C. (2010a). La pédagogie de l'enquête dans l'éducation au développement durable. In Y. Alpe & Y. Girault. (Éds.), Actes du colloque « Éducation au développement durable et à la biodiversité : Concepts, questions vives, outils et pratiques » (pp. 334-351), Digne les Bains : IUT de Provence. https://halshs.archives-ouvertes.fr/halshs-00957843/document

Chevallard, Y. & Ladage, C. (2010b). Enquêter pour connaître : L'émergence d'un nouveau paradigme scolaire et culturel à l'âge de l'Internet. Journée de réflexion sur le thème « Une approche anthropologique du didactique », Liège : Institut de mathématiques. http://yves.chevallard.free.fr/spip/spip/IMG/pdf/Colloque_de_Liege_15-10-2010_YC_CL_.pdf

Coleman, G. (2010). Ethnographic Approaches to Digital Media. *Annual Review of Anthropology*. *39*(1), 487–505.

Dewey, J. (1938, 2013). *Logic the theory of inquiry*, Londres: British library/Read books ltd.

Froehlich, D.E., Van Waes, S. & Schäfer, H. (2020). Linking Quantitative and Qualitative Network Approaches: A Review of Mixed Methods Social Network Analysis in Education Research. *Review of Research in Education*, *44*(1), 244–268. https://www.researchgate.net/publication/340820343_Linking_Quantitative_and_Qualitative_Network_Approaches_A_Review_of_Mixed_Methods_Social_Network_Analysis_in_Education_Research

Hine, C. (2017). Ethnography and the Internet: Taking Account of Emerging Technological Landscapes. Fudan Journal of the Humanities and Social Sciences, Springer, *10*, 315–329. https://doi.org/10.1007/s40647-017-0178-7

Illingworth, N. (2001). The Internet Matters: Exploring the Use of the Internet as a Research Tool. *Sociological Research Online*, 6(2), 79–90. https://doi.org/10.5153/sro.600

Jones, S. (Ed.). (1999). *Doing Internet research: Critical issues and methods for examining the Net*. Sage Publications.

Kim, S. (2015). *Les besoins mathématiques des non-mathématiciens : quel destin institutionnel et social ? Études d'écologie et d'économie didactiques des connaissances mathématiques*. Doctoral dissertation, Aix-Marseille University.

Ladage, C. (2008). *Étude sur l'écologie et l'économie des praxéologies de la recherche d'information sur Internet. Une contribution à la didactique de l'enquête codisciplinaire*. Doctoral dissertation, Aix-Marseille University.

Ladage, C. (2017). *Enquêter pour savoir. La recherche d'information sur Internet comme solution et comme problème*. Rennes : PUR, Coll. Paideia.

Ladage, C. (forthcoming, 2022). Enquêter sur Internet : Quels recueils de données ? In B. Albéro & J. Thiévenaz (Éds.). *Traité de méthodologie de la recherche en sciences de l'éducation et de la formation : Enquêter dans les métiers de l'humain*.

Ladage, C. & Chevallard, Y. (2011). Enquêter avec l'Internet : Études pour une didactique de l'enquête. *Éducation & Didactique*, *5*(2), 85-115. https://journals.openedition.org/educationdidactique/pdf/1266

Landers, R.N., Brusso, R.C., Cavanaugh, K.J. & Collmus, A.B. (2016). A Primer on Theory-Driven Web Scraping: Automatic Extraction of Big Data From the Internet for Use in Psychological Research. *Psychological Methods*. *21*(4), 475–492. https://doi.org/10.1037/met0000081

Peirce, C.S. (1931). *The Collected Papers: Principles of Philosophy*, Tome I.

Redondo, C. (2018). *Étude didactique des praxéologies de l'éducation au développement durable : Des fondements épistémologiques des pédagogies de l'EDD.* Doctoral dissertation Aix-Marseille University.

Stengers, I., (2002/1997), *Sciences et pouvoir*, Paris : La Découverte.

Stryckman, P. (1996). De la méthode. *Communication et organisation*, *10*. https://doi.org/10.4000/communicationorganisation.1867