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TOWARD A SOCIOMATERIAL APPROACH TO KNOWLEDGE TRANSFER

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Abstract

Knowledge sharing is one of the most important preoccupations of organizational literature. Until recently, knowledge literature has largely assumed an idealist conception of knowledge that posits the production of knowledge as disinterested and individual endeavor. However, these insights are limited in large part because they overlooked the way in which organizing is bound up with materiality. Based on a sociomaterial conception of knowledge, we claim that our ways of dealing with materiality in organization research, and especially in knowledge literature, are conceptually problematic. We argue for an alternative approach, one that posits the constitutive entanglement of the social and the material in everyday life. We draw on one case study to illustrate this approach in practice and conclude that a reconfiguration of our conception of knowledge will be useful to understand the complexity of sociomaterial assemblages entailed in contemporary organizations.

Keywords: materiality, knowledge research, sociomateriality.

Many organizations increasingly rely upon information and communication technologies (ICTs) to support knowledge transfer. ICTs offer multiple opportunities to support knowledge sharing in organizations, especially within geographically distributed organisations. Groupware is designed to facilitate communication between people by providing support for distributed electronic interaction (Orlikowski, 2000). Another example of ICT supporting knowledge transfer is that of databases used by project members to capture the knowledge and learning from their projects. Once the knowledge has been captured and stored in the database in the form of documentation, other project teams can access these documents and therefore learn from them.

However, knowledge transfer literature largely disregarded the role of ICTs and of materiality. On one hand, research studies from the "knowledge as possession" perspective have gone into patterns of dyadic knowledge transfers across units of MNCs. These studies focused on technology transfer and adoption as separate and distinct phenomena occurring within organizations. As such, technology is only studied in certain organizational circumstances. Materiality, in this perspective, is a special case, and this is problematic because it takes no account of the entailment of materiality in every aspect of organizational life. On the other hand, the constructionist approach regards knowledge translation as a situated and ongoing process through which knowledge is passed from actors to actors by translation agents which have their own reason for performing the action (Gherardi and Nicolini, 2000). The constructionist perspective embraces knowledge as being socially constructed. In this view, knowledge is constituted and translated through practices and activities. This approach considers knowledge and knowing as being inextricably tied to the material and social circumstances in which they are acquired (Gherardi and Nicolini, 2000). Drawing on these influences, we suggest that knowledge transfer literature can gain considerable insights if it moves towards a perspective of constitutive entanglement (Orlikowski, 2007). The notion of constitutive entanglement presumes that technology, as well as humans, is constitutive to organizational life. The material and the social are considered to be inextricably related, as Orlikowski puts it (2007: 1437): "*there is no social that is not also material, and no material that is not also social*". We seek to build on the existing literature by examining the knowledge transfer process as a sociomaterial phenomenon, which implies that the material is intrinsic to organizing. Such a perspective suggests that, just like humans, technology contributes to organizational life.

After a review of the literature on knowledge transfer, the research methodology is presented. Next, we describe the implementation and use of a Learning Management System, called Moodle, by a French university. The focus here is on how organizational practices become increasingly entangled with emerging sociomaterialities. We end with a discussion of theoretical implications and avenue for future research.

1. Existing view of materiality in knowledge transfer research

Two prominent ways of dealing with materiality coexist in knowledge transfer research:

- The first way suggests that the knowledge transfer process may be influenced by the material conditions in which the transfer takes place.
- The second way consists in studying specific cases of technology transfer between organizations.

Knowledge transfer literature regards knowledge as an objective entity that can be codified, stored, and later retrieved by anyone. This assumption leads scholars to focus on the determinants to transfer success. Using the signalling metaphor, they have determined four sets of factors which influence knowledge transfers: the characteristics of knowledge (tacitness, complexity, specificity and availability), the characteristics of the sender and receiver (willingness and ability of the sender to transfer, absorptive and retentive capacity of the receiver), and the characteristics of the relationship between the sender and the receiver. Without any explicit treatment of the material artifacts through which practices are performed, this literature suggests the possible influence of the material context on the knowledge transfer process. *Causal ambiguity* is advocated when the precise reasons for failure or success in transferring a capability in a new setting cannot be determined even ex-post (Szulanski, 1996). As Szulanski (1996: 31) puts it: “*Causal ambiguity can also result from imperfectly understood idiosyncratic features of the new context in which knowledge is put to use (Tyre and Von Hippel, 1997)*”. The ‘idiosyncratic features’ that Szulanski talked about, clearly referred to the material and social conditions in which the transferred knowledge is implemented. In a seminal study, Almeida and Grant (1997) identified 13 mechanisms through which knowledge flows between countries, from face-to-face meetings to electronic mails and the telephone. This study highlights the use of material artifacts in multinational companies for mediating knowledge diffusion. This instrumental view of materiality tends to reify technology, ignoring how materiality is bound up with historical and cultural contexts in which the transfer occurs. Despite such vague and pervasive

examples, materiality has been largely ignored by the ‘knowledge as possession’ perspective.

Since the 1960s, there has been a growing body of literature concerning technology transfer which is aimed at understanding the enabling and constraining conditions as well as the consequences of technology transfer (Becker-Ritterspach and Dörrenbächer, 2008). However, some research is more concerned with the appropriateness of the technology transferred. Teece (1977) distinguishes two basic forms in which technology can be transferred (1977: 232): “*The first form embraces physical items such as tooling, equipment, and blue prints. Technology can be embodied in these objects. The second form of technology is the information that must be acquired if the physical equipment or ‘hardware’ is to be utilized effectively.*” Technology transfer costs are therefore defined as the costs of transmitting and absorbing all of the relevant unembodied knowledge. Furthermore, transfer costs vary considerably depending upon the number of previous applications of the innovation, and how well it is understood by the participants. This stream of research has provided numerous insights into the role of technology in the transfer process, but, in doing so, has generated some conceptual difficulties for dealing more broadly with materiality in knowledge transfer research. The main difficulty concerns the explicit focus on technology transfer as distinct phenomena occurring within organizations (Orlikowski, 2007). In this view, materiality is a special case, and this, doesn’t reflect the reality of organizations. Consider any organizational practice, and it quickly comes to mind that “*materiality is not an incidental or intermittent aspect of organizational life; it is integral to it*” (Orlikowski, 2007: 1436).

In recent years, a number of versions of knowing processes have emerged to challenge the very foundation of the rationalist tradition which established the basis for the main stream of knowledge transfer literature. Based on work carried out in such diverse fields as sociology of knowledge, ethnomethodology, social anthropology, psychology and technology, these alternative conceptualizations transcend conventional distinctions between the social and the material. What makes the particularity of such developments significant is their insistence on speaking about the social and the material in the same register, and not relapsing into a limiting dualism that treats them as separate entities. The Actor Network Theory (Callon, 1992; Latour, 1992) endeavors to describe the very nature of societies. As they do so, scholars do not limit themselves to human actors but extend the word actor to non-human, non-individual entities. In ANT, an actor is by semiotic definition an *actant* (something that acts). To expound, an actor is

characterized first-hand by its capability to act and interact, and “*an actant can literally be anything, provided it is granted to be the source of an action*” (Latour, 1996).

Drawing on these influences, we suggest that knowledge literature can gain considerable analytical insights if we give up on treating the social and the material as distinct and independent dimensions of organizational life (Orlikowski, 2007). In particular, this requires replacing the conception of knowledge as a mental substance residing in members’ heads with that of ‘a distributed social expertise’. As Gergen (1991: 270) observes: “*knowledge is not something that people possess in their heads, but rather, something that people do together*”. And Latour (1987) added that people not only interact with each other but also with the non-humans.

The notion of constitutive entanglement asserts that there are no independently existing entities with inherent characteristics (Barad 2003: 816). Humans are constituted through relations of materiality – bodies, clothes, computer, pencil, which in turn, are produced through human practices. The following case study will help to ground and illustrate how we may begin to study the constitutive entanglement characterizing sociomaterial practices.

2. Methodology

The article deals with a case study of the implementation and use of a Learning Management System, called Moodle, by a French university. Moodle is a tool for teaching staff to create online, dynamic web sites for their students. Moodle has features that make it possible to build collaborative communities of learning, to deliver content to students, or assess learning using assignments or quizzes. Using the method of a single case study (Easton, 2003; Flyvbjerg, 2007), the exploration of Moodle design, configuration and use is likely to generate in depth insights into how organizational practices become increasingly entangled with emerging sociomaterialities.

As common in qualitative interpretive case studies, data collection relied intensively on semi-structured interviews. Data collection was carried out in 2011 on the campus of Schoelcher. Table 1 summarizes the respondents' profile. Interviews lasted one hour on average and were recorded and transcribed.

To improve the validity of the study, the data was triangulated by applying three data sources: interviews, observation and documentation (Eisenhardt, 1989). We have also contrasted the perspectives of different respondents (e.g., students, administrators and teachers). Finally, intermediate versions of the analyses were offered to both actors in

the field and academic peers. This confrontation with alternative explanations helped to build a strong interpretation of the case.

Data analysis placed a significant emphasis on verbatim quotations from informants. All recorded interviews were analyzed via methods of inductive reasoning and comparative methods. Following the procedure advocated by Strauss and Corbin (1998), three types of coding were adopted to analyse the data. First, ‘open coding’ was used to discover and identify the features and dimensions of concepts in the data. Second, ‘axial coding’ was employed to develop connections between core categories. Third, ‘selective coding’ was used as a process of integrating and refining theory. In line with the interpretive nature of this research, the study relied on highly iterative and recursive processes of data collection, analysis and theoretical framing (Alvesson and Deetz, 2000).

Table 1. Interviews

Interviewees profiles	
Students	25
Administrators	4
Teachers	11
Total	40

3. Teaching with a Learning Management System

The *Université des Antilles et de la Guyane* (UAG) is a French university based in the French West Indies. The university has five campuses: two in Guadeloupe (Fouillole and Saint-Claude), one in Martinique (Schoelcher) and two in French Guiana (Cayenne and Kourou). The distance between Guadeloupe and French Guiana is almost 1 600 kilometres (994 miles) and that between Guadeloupe and Martinique is 200 kilometres (124 miles). 13 300 students are enrolled in UAG which offers undergraduate and graduate degree programs in a wide range of disciplines from medicine to literature. The university president and the academic administration are located in Guadeloupe where there are 6 000 students. The student population in French Guiana and Martinique is 1 700 students and 5 600 students respectively. The university is made up of six departments and five professional schools. The economics and law departments, the humanities section and a part of the faculty of medicine school are located in Martinique, whereas the mathematics, physics, biology departments and, to a lesser extent the economics department, are based in Guadeloupe. In French Guiana, there are

three institutes: the first specialized in engineering and medicine, the second in law and economics, and the third in humanities.

UAG is facing a major challenge related to the allocation of resources among the five campuses. The distance (almost 994 miles between Guadeloupe and French Guiana and 124 miles between Guadeloupe and Martinique) makes resource sharing difficult. For example, each campus has its own sports infrastructures, library and cafeteria. The Chancellor calls for more involvement into research activities and for more implication into the territories. He wants to establish the university as a reference in terms of biodiversity, sustainable development, healthcare, and tropical environment. UAG must also offer diplomas more related to the structure of the local economy in which the university is located.

Teaching is a central practice of full-time faculty members, especially in French universities where the amount of time devoted to teaching is particularly high. A researcher spends almost 250 hours per year teaching. The rest of the time is devoted to research, administrative duties and course preparations. Teaching in any case involves forming a lesson plan, presenting material to students, responding to students learning needs, and evaluating students' progress. In order to enhance resource sharing, the University adopted a new Learning Management System, called Moodle.

3.1. What is Moodle?

Moodle (for Modular Object-Oriented Dynamic Learning Environment) is a open-source e-learning software platform very popular among educators around the world. Moodle allows for the creation of online dynamic web sites where educators virtually meet their students. By the first October 2010 Moodle had a user base of 49 952 registered sites with 36 920 681 users in 210 countries, in 3.7 million courses. The Moodle project comprises several elements:

- The software.
- Moodle Pty Ltd, Moodle Headquarter where the development of the core platform is administrated.
- The Moodle Community, an open network of over one million registered members who interact via the Moodle Community Website to share ideas, information and free support. This community includes developers with Moodle's open source license allowing any developer to create additional modules and features.
- The Moodle Partner network which collects royalties to fund Moodle Pty Ltd activities.

Moodle has several features considered as typical for an e-learning platform, as well as some original innovations. Developers can extend Moodle's infrastructure by creating plug-ins for specific new functionalities. Moodle can be used to conduct courses fully online or, in most cases, to support face-to-face teaching and learning.

Moodle has several basic functionalities similar to most e-learning platforms. On the course settings page, the teacher may add resources (texts, images, internet links, videos...) and activities by using the "Turn editing on" button on the course homepage. With the "Add an activity" drop down menu, teachers can choose among a wide range of activity modules. Communication and collaboration may take place using live "Chats" or asynchronous discussion "Forums" for conversational activities. You can also use "Choices" to allow the class to vote on which direction they would like their course to take. Adding "Wikis" to a course is the best way for students to work together on a collaboratively-authored project. Work can be submitted by students and graded by teachers using "Assignment" or "Workshops". The "Assignment" activity module allows teachers to collect work done by students, grade it and provide not only grades but constructive feedback. Students can submit homework or type directly into Moodle using the "Online text" assignment. There is also the "Offline activity" assignment to remind students of 'real-world' assignments they need to complete. These modules have several assessment options, including instructor-assessment, self-assessment and peer-assessment. The "Quiz" activity module allows the teacher to design and set quizzes consisting of different types of questions (multiple choice, true-false, and short answer questions). The "Question bank" memorizes the questions that can be used in multiple quizzes. Quizzes can be configured to allow students to make multiple attempts. Each attempt is automatically graded and the teacher can choose either to give feedback or show the correct answers. Quizzes may be designed via Moodle or created on the teacher's computer and then uploaded to the Moodle course via the "Hotpot" activity module. "Lesson" and "SCORM" activity modules deliver content and offer ways of individualizing your presentation based on a student's choice. With the "Lesson" module, each choice the student makes, can show a different teacher response or comment and send the student to a different page in the lesson. Thus, with planning, this module allows for customization of the presentation of content and questions to each student, with no further action being required by the teacher. Teachers can also add "Glossary" activity to their course. The "Glossary" module allows the participant to create and maintain a list of keyword definitions available to students. A glossary can be collaborative, allowing each participant to add new definitions or complete existing

ones, or entries only made by the teacher. With the “Database” activity module any participant in a class can build, display and search a bank of record entries (text, images, videos, URLs...) on any topic. The “Survey” activity module provides a wide range of survey instruments to teachers who can gather data from their students that will help them learn about their class and reflect upon their own teaching. These activity modules constitute the basic design of Moodle. If any member of the users community expresses any other needs that the standard Moodle platform doesn’t offer, developers can then add any number of contributed modules.

3.2. Moodle at UAG

The STICE (*Service Commun des Technologies de l’Information et de la Communication pour l’Enseignement*¹) is composed of one president mandated by the University Chancellor, one regional vice-president, one engineer specialized in learning technologies, as well as technicians. The mission of the technical team is to administrate the platform. STICE members operate on three campuses: Schoelcher in Martinique, Fouillole in Guadeloupe and Cayenne in French Guiana. In Martinique, the local team is made up of one Vice-President, Phillipe, one engineer, Giliane, and two programmers.

The STICE administrates the learning platform of the university. The engineer conducts training session on Moodle dedicated to teachers. She also trains students who can obtain the C2i which is a certificate that certifies the holder has mastered certain Information Technology tool skills. Developing, strengthening and validating the mastery of information and communication technologies by students is the aim of this certificate. Moodle has been chosen and installed at UAG by the STICE because of its modularity. Before Moodle came along, UAG had been using an e-learning platform called Ganesha. Contrary to Moodle, Ganesha wasn’t free and open-source, therefore the adjunction of new functionalities was limited. According to Giliane: “*With Ganesha, when somebody needed something specific, he asked the developers who, eventually did it. With Moodle, the community of users is so huge that, most of the time, needs had already been expressed somewhere, a developer had already developed the corresponding module, therefore, we only had to download it.*”

The replacement of Ganesha by Moodle took place in 2007. At that time, there were only a few resources on Ganesha (only ten courses). In 2009, the number of connections per day was about 700. Between 2009 and 2010, the number of connections increased by 50%, reaching 2 000 connections a day. There are about eight thousand active users of Moodle at UAG; the active user is somebody who regularly connects to the platform.

¹ Collective department of information and communication technologies dedicated to learning.

This increase in connections is related to the way Moodle has been configured by the STICE. The Moodle platform, as implemented within UAG, is configured to continually ‘push email’ to the users email addresses, therefore each time a course that is related to the last one in which the user has participated is created, Moodle users receive an email to alert them, with a link to the related course. The “proposition to participate” received by email takes into account your last activity on the platform. Similarly, each time the teacher adds something new (maybe new resources, new event on the calendar, news...) on the course settings page, registered users receive an email to let them know. In this e-mail, there is a link to the post. While the students can choose when to look at their emails and whether or not to click on the link to participate in the proposed course, most of them reports by clicking immediately on the link to finalize their registration. As an undergraduate student reported: *“Each time I received a ‘Moodle email’ I open it immediately because it may be an important message from one of my teachers concerning the date of an exam as well as a cancelled course. Sometimes, teachers forget to tell us information in class and they do it via Moodle because they know we all read frequently our emails, even in class we still connect via the campus wireless network”*.

3.3. Moodle in practice.

The Moodle platform, as implemented by the STICE, is sociomaterially configured to let users choose the courses they want to take part in, and this in spite of the ‘push email’. In order to use the platform, students must complete their faculty registration and possess a numeric account. The numeric account is granted by the CRI (*Centre de Ressources Informatiques*²) which coordinates and implements the information and communication technologies (ICTs) strategy of the University. The CRI administrates the whole technology infrastructure of the University and provides academics and each registered student with an e-mail account. Without this account, university members cannot use the Moodle platform. As a result, Moodle use at UAG depends on the CRI’s ability to provide numeric accounts to the all university members: academics, administrative personnel, students and visiting teachers.

Courses settings pages are created by the STICE at the request of teachers who send a e-mail to the STICE each time they want to open a new course setting page indicating a certain amount of information: teacher relative data (name, email, telephone number, faculty department), the course name (area, degree, cycle), the semester, the campus

² Center for Computer Resources

location, the date to give access and the administrative code of the course. Within one week at the maximum, the course setting page is created and the teacher can add resources and activities. There are two types of teachers using Moodle at UAG: firstly there are the “first movers” who have been using the platform since its installation in 2007; secondly, there are the “new comers” who use Moodle under the pressure of the administration and students. If students don’t find a course on the platform because the teacher didn’t open any course setting page, they can report it on their ‘wish list’. The ‘wish list’ is a tool designed by the STICE to enhance creations of courses settings pages. Each student can fill in a wish list where they indicate the courses they want to see on Moodle. The STICE centralizes the wish lists and generates statistics to determine the choices that students have made. They send email to the concerned teachers to get them to participate in training sessions dedicated to Moodle use.

On the Moodle platform configured by the STICE, course setting pages are organized by fields and degrees in accordance with the courses map offered by the University. The students select a field and then the list of courses available appears. Some courses are open to every participant while others are protected by a key entry and are visible only to registered participants or those who possess the key entry.

Giliane, the STICE engineer of the Schoelcher campus, has created a forum to collect users’ advice as well as questions about Moodle use and functionalities. When a teacher expresses a need, the STICE try to propose an answer as soon as possible. The technical team searches on the Moodle network to see if a corresponding application has already been developed elsewhere. If so, they download it and install the application on the local platform. If there is no existing answer, they developed one by themselves.

For example, one UAG teacher needed a tool that allows students to manage the planning of their oral assignments. This teacher wanted the students to be able to choose the day and time slot they are available on a schedule where they can see the assignment hour of the other students. Students can modify their choices up to a date indicated by the teacher. After this date, there is no modification possible. To satisfy this teacher need, the STICE follows this procedure: *“The standard Moodle platform didn’t offer this possibility, so, we found a tool which had been developed by another university that we uploaded, free of charge of course; that’s what we call collaboration.”*

This method, which consists of responding to each expressed need one by one, allows for a quick evolution of the platform. In only few months, almost twenty new modules were created by the STICE at the request of users. *“It seems that the more people use the platform, the more they ask for new developments. When they want to do something*

they can't do, they automatically post a question on the forum, and check frequently until they get a response."

The UAG Moodle platform is not static, but dynamic and relative to users' needs. As worldwide developers continually create new modules, the platform is continually updated because of the number of new modules added each month. Not only are courses settings pages being added to and deleted from the platform every day, but existing courses settings pages are being modified, with activities, resources or modules being added and deleted. And these ongoing changes are reflected in 'wish list' content and the nature of the "proposition to participate" received. Indeed, the content of wish lists evolves depending upon the courses settings pages creations and the "proposition to participate" depends on your recent activity and subsequently of the number of courses settings pages available. The Moodle's search module is also influenced by these changes. In fact, the list of courses obtained with a Moodle search done today will shape research practices differently than had the Moodle search been done next week or last month.

4. Discussion and conclusion

In this paper, we have argued that much of the knowledge transfer literature, particularly the "knowledge as possession" perspective, disregards or ignores the everyday materiality of organization, and we called for a shift in our way of dealing with materiality in organizations. Drawing upon the constructionist perspective, we argue that all knowledge is always and everywhere sociomaterial, and that this sociomateriality has consequences on organizational processes such as knowledge transfers. The example of Moodle mediation is the manifestation of organizational knowledge becoming increasingly entangled with emerging sociomaterialities.

Implications of sociomateriality for the knowledge transfer process conception

The sociomateriality of knowledge has several implications for our conception of knowledge. Drawing on the socioconstructionist perspective, we argue that knowledge is always sociomaterial. In this view, knowledge resides neither in people's heads nor in technology. Knowledge is inextricably bound up with the material and social context in which it is acquired. In the previous sections, we have shown that knowledge transfers enacted at UAG emerge from the performativity of Moodle as engaged in actors' - students, administrators and educators - everyday practices. It is not a matter of the material functionalities of the Moodle platform leveraging human action, or the development of new plug-ins making knowledge transfer more efficient or effective, but

rather of constitutive entanglement. The performativity of Moodle is sociomaterial, shaped by the contingent way in which Moodle is designed, configured and engaged in practice. For example, the 'Resource' module inscribes into the software running on the university server has become entangled with people's choices and activities; to log in to the platform, to bring content into a course, to upload files, to check regularly for new files, to download files and to learn the downloaded files. Such activities are only relevant in the circumstances of users being trained to use the software and its features, and of shifting interpretation and interests that have become bound up with the ability to use the software. It is not a question of the technology impacting the social, but rather of constitutive entanglement.

As a sociomaterial processe, knowledge 'creation' at UAG is significantly changing why, when, where and how members interact. Norms of communication within the university are reconfigured, altering students' expectations in terms of course content, modifying expectations of availability, redefining the boundary of the classroom, and extending and intensifying interactions within the communication network. UAG students experience increased autonomy, whereas teachers and administrators are facing the increased obligation to update available resources and to add additional features to the platform. The resulting intensification of collaboration – between students and teachers, between students, and between teachers - is beginning to reduce the impact of distance between the different campuses UAG.

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