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On sociomaterial imbrications: What plagiarism detection systems reveal and why it matters

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ABSTRACT

In the context of an increasingly mobile student population, and Greek students specifically, this paper opens up and reveals the manner in which a specific culturally situated human actor (the Greek student) and a specific culturally situated non-human actor (the plagiarism detection system) encounter, interpret and constitute each other within the situated context of the UK higher education system. Methodologically, we base our paper on a longitudinal in-depth case study that focussed on the teaching, learning and assessment practices in Greek public sector universities. Based on our Greek case example we specifically focus on how the delegation of plagiarism detection to a technical actor produces a particular set of agencies and intentionalities (a politics one might say) which unintentionally and unexpectedly conspires to constitute some students as plagiarists (who are not) and others as not (who are). We suggest that this is best explored by looking exactly at what is rendered visible and invisible in such imbrications. This has important implications for the design, implementation and use of IS in situated contexts.

1. Introduction

> *'Language matters. Discourse matters. Culture matters. But there is an important sense in which the only thing that does not seem to matter anymore is matter.'* Barad (2003, 801)

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In what way does information technology matter to organisational actors? In many respects one could respond by suggesting that it depends on the sort of organisational actors which one might refer to in such a question. If it is the designers of IT systems then it matters as a 'design' problem/solution. If it is the users of the IT systems then it matters as a 'useful' technology which may 'make things easier' or more efficient, etc. In other words there are many different ways in which IT matters to different organisational actors who might approach IT as a particular problem/solution for their specific purposes. Clearly all of these ways of 'mattering' are important for their own specific reasons. However, we would suggest, with Orlikowski (2007) and others, that these questions (and the actors that pose them) are already circumscribed by a more fundamental question about the nature of materiality itself—i.e. *how and what it is* when we encounter technology as a design, implementation or use problem/solution. In other words our design, implementation or use questions are already framed or circumscribed by our ontological assumptions about the nature of the technological domain (and materiality more generally)—i.e. those very assumptions we already assume (mostly implicitly) when we go about designing, implementing and using information technology. Traditionally, in IS research, and social theory more generally, these ontological assumptions – about the relation between the technical and the social – tend to privilege the situated human agent as the principle source (or agent) that shapes the largely passive technical domain in order to achieve human ends. For example, in posing these questions we tend not to ask the question of how (or in what way) humans matter to information technology—except as an indirect reference to, or as an proxy of, human actors (such as designers, users, managers, etc.). Located within this human-centric world-view we humans have increasingly turned to technology as tools in the service of our needs—that is, without appreciating that it is not only us that make them, they also make us. More specifically, in the imbrications[1] of the social and the technical there exists what Orlikowski (2007) calls "constitutive entanglements" which flows in both directions (see also Introna, 2007), often with unintended and contradictory outcomes—as we will show below.

In order to problematise this human-centric ontology of sociomaterial imbrications we want to describe (open up and reveal) the manner in which a specific culturally situated human actor (the Greek student) and a specific culturally situated non-human actor (the plagiarism detection system) encounter, interpret and constitute each other within the situated context of the UK higher education (HE) system. The student population is increasingly mobile, where students leave their home country to undertake undergraduate and postgraduate study abroad. The UK is a popular destination for such students,[2] and Greek students have historically been one of the largest national groups to study in the UK. One of the concerns that has emerged in the literature and anecdotally in relation to the mobility of students, has been the view that international students often enter the UK HE sector with significant 'deficits' in, for example, academic writing and academic literacy more generally (Scollon, 1995; Howard, 1993, 1995; Deckert, 1993). Many claim that this deficit manifests itself in cases of intentional or unintentional plagiarism (Park, 2003; Evans & Youmans, 2000; Harris, 2001; Carroll & Appleton, 2001; Lathrop, 2000; Dryden, 1999; Myers, 1998; Pennycook, 1996; Sherman, 1992; Kolich, 1983; O'Connor, 2003). Most universities in the UK have responded to this perceived increase in plagiarism by introducing the so-called plagiarism detection systems (mostly Turnitin) to detect and deter plagiarism. In this paper we will show how in this encounter—or rather mutual enrolment as Latour (2005) would say—the actors (human and non-human) frame each other in ways that leads to contradictory outcomes. Outcomes in which some students are constituted as 'plagiarists' (who are not) and others as being not (who are)—obviously with devastating consequences for those involved. In order to understand how such a contradictory (and intensely political) outcome emerges *we need to show how certain interpretive frames emerge as the implicit outcome of historical and culturally situated sociomaterial practices*. Furthermore, we need to show how these assumed interpretive frames (of the human and the non-humans) become implicated in the ongoing imbrications (of the social and the technical) as actors move from one context (the Greek HE system) to another (the UK HE system). This is the aim of this paper.

However, we should note that the purpose of the paper is not to comment on the Greek or UK HE systems as such (or higher education more broadly). Rather our purpose is to show more generally that

[1] The term 'imbrication' literally refers to overlapping, but mutually supporting layers (as used in tiling, for example). The sociologist Saskia Sassen uses this concept to account for the overlapping of IT and social practices and the way in which that such overlapping implicate each other (see for example Sassen, 2002). More recently this notion was also used by Leonardi (2011).

[2] In 2003 there were 2.12 million OECD students studying abroad of which 254,400 students (12%) were studying in the UK (Kritz, 2006)—the second largest destination after the USA.

actors (both human and non-human) in culturally situated sociomaterial practices always already enact interpretive frames of each other which are inscribed (or embedded) within these very practices. Thus, when these actors become mobile and become relocated they are bound to enact (or be enacted within) inappropriate interpretive frames that may lead to consequences not intended by any of the actors as such. In other words the intentionality of the sociomaterial network transcends the intentionality of any or some of the actors. This is clearly an important conclusion for the discussion of design, implementation and use of IS in situated contexts. It is our hope that our study of plagiarism detection systems will lead to a more nuanced understanding of the transfer of sociomaterial actors from one context (or network) to another—especially with regard to the *unintended ethical and political consequences* of becoming configured in a different network of heterogeneous sociomaterial practices.

This paper is structured as follows. The second section will review our conceptual underpinnings pertaining to sociomaterial networks, especially the work of Bruno Latour. Section three presents our culturally situated human actor (the Greek student) with reference to teaching, assessment and learning found in Greek public sector universities. This is followed by section four, which introduces our culturally situated non-human actor (the software algorithms for detecting textual copies) and the nature of its situatedness within the UK HE system. Section five will draw on the previous sections to discuss or describe how these two actors (the Greek student and the plagiarism detection system) encounter, interpret and constitute each other within the situated context of the UK HE system, with many unintended consequences. The final section presents some implications and conclusions, first in relation to our case study, and second in relation to a human-centric ontology of sociomaterial imbrications more generally, especially with regard to the unintended ethical and political consequences of such imbrications.

2. On heterogeneous sociomaterial imbrications

We have suggested above that heterogeneous sociomaterial imbrications matter because they constitute other actors in unimagined and unintended ways—in other words they have ethical and political consequences. Winner (1986, 1999) has argued that technological artefacts have politics. By this he meant that technology, by its very design, includes certain interests and excludes others, or more generally the fact that "specific features in the design or arrangement of a device or system could provide a convenient means of establishing patterns of power and authority in a given setting" (Winner, 1986, p.36). Not everybody agrees with Winner's analysis. Strong social constructivists such as Grint and Woolgar (1995) argue that: "The politics and values of technology result from the gaze of the human; they do not lie in the gauze of the machine…" (p. 306). Others, such as those in the value centred design tradition (Friedman, Kahn, & Borning, 2006; Friedman & Nissenbaum, 1996; Brey, 1999, 2004) suggest that it is in the *interaction* between the software code (functions and features) and human practices where the political dimension is located. Thus, for them, we need to study the technology *and* how the technology is used to reveal the political. The debate about 'where' the politics and values 'are', i.e. in the technology or in the users is a longstanding debate in social studies of technology—see for example Kling (1992), Brey (1997) and Radder (1992) for more on this debate. Whilst there are a number of different positions that have been developed with regard to understanding the nature of agency within sociomaterial networks, we draw on the constructivist approach of Latour (1991), Haraway (1991) and Barad (2003), amongst others.

The constructivist tradition suggests that the attempts to locate politics in the 'social' or the 'technical' are not relevant at all because *the social and the technical are a unity from the start*—they have never been otherwise (Latour, 1991, 2002, 2003, 2005; Orlikowski, 1992; Orlikowski & Gash, 1994; Orlikowski, 2000, 2007; Ciborra, 1993; Orlikowski & Gash, 1994; Ciborra, 2002; Introna, 2007; Verbeek, 2005). For Latour (1991, 2002, 2003, 2005) any talk of humans and non-humans in ways that would suggest that they are separately already what they are – as 'social' and 'technical' – and then we 'add' them together to 'make' a sociomaterial network is simply wrong. Latour (2003) suggests that both humans and non-humans share a common constitutive history: "Humans and non-humans are engaged in a history that should render their separation impossible" (p.39). More than that, they do not merely share a common history; they are each other's common history: "A body corporate is what we and our [technology] artefacts have become. We are an object institution" (Latour, 1999, p.192, emphasis added). In this 'object institution' (or heterogeneous network), he argues, it may not be possible to simply allocate intentionality and properties this way or that

way: "Purposeful action and intentionality may not be properties of objects, but they are also not properties of humans either. They are properties of institutions [networks of humans and non-humans], apparatuses…" (Latour, 1999, p.192)—or are properties of heterogeneous sociomaterial networks (also refer to Introna & Nissenbaum, 2000; Introna & Whittaker, 2006 and Gasson, 2006 for examples of heterogeneous sociomaterial networks).

It is clear from these comments that Latour is talking about the human/non-human relationship as a fundamental *co-constitutive unity* in ways very similar to the philosopher Martin Heidegger (1962). One of the important consequences of Latour's and Heidegger's position is that our encounter with technology is always *ontologically* conditioned from the very beginning, and in some fundamental way, by the horizon of intelligibility within which we already find ourselves—it is already in some strict sense pre-given. In other words, in our everyday world of ongoing activity our encounter with technology is not unprecedented in such a way that we need to continuously interpret and make sense of it afresh in some idiosyncratic way. Rather, we tend to take up objects in the way they already show themselves in the world in which they are encountered as this or that particular thing—within an already implicitly existing relational whole. In this regard Ciborra (1993, 29) and Ciborra and Lanzara (1994, 70) have suggested that our understanding of, and encounters with, 'technical actors' (as embedded within organisational routines) are already constituted by the *formative context* within which such encounters by implication happen. Ciborra (1993) defines formative context (in following Unger, 2004) as "the set of institutional arrangements and cognitive frames and imageries that actors bring and routinely enact in a situation." He argues that the formative context "constitutes the background condition for action, enforcing cognitive and practical constraints, giving direction and meaning, and setting the range of opportunities for undertaking action." As such it functions in a subtle and implicit way for the ongoing conditioning of the possibilities for interpretation and action of all actors—giving it an "aura of naturalness." In a similar manner Orlikowski and Gash (1994) argued that our encounters with 'technical actors' are implicitly or explicitly constituted through the technological frames we already have of them. They argue that organisational actors "make sense of [technology]; and in this sense-making process, they develop particular assumptions, expectations, and knowledge of the technology, which then serve to shape subsequent actions toward it. Whilst these interpretations become taken-for-granted and are rarely brought to the surface and reflected on, they nevertheless remain significant in influencing how actors in organisations think about and act toward technology" (175).

This work of Ciborra and Orlikowski has been very influential in IS research[3] and draws on the long tradition of interpretive theory which argues *that there is a co-constitutive relation between the text(part) and the context(whole)*—for example in the hermeneutics of Gadamer. However, we should be careful not to suggest that the technical actors are 'text' and humans (values, assumptions, practices, etc.) are 'context'—in other words that the interpretive (and constitutive) relation only flows in one direction from the human to the technical. Looking at the definitions of formative context and technological frames provided above (as well as the way this work is often used) one might be inclined to come to such a conclusion. This would be a very serious misunderstanding of the important insights provided by the constructivist perspective (especially the work of Latour). Technical actors enact interpretations of us humans as much as we enact interpretations of them (as we will show below)—in our imbrications with them they constitute us even as we attempt to constitute them. In our sociomaterial imbrications we humans are their context as much as they are also simultaneously our context—technological frames (or rather sociomaterial frames) operate in both directions. Thus, the text/context distinction is always *within* the imbrications of the heterogeneous network. There are no privileged actors that can stand on the *outside* (some might say context) of the network looking in, as it were (not even the authors of this paper). All actors are always and already more or less entangled in (and constituted by) the heterogeneous network. Text and context are analytical (not ontological) distinctions—or 'cuts' as Barad (2003) would say—we sometimes need to make and use as part of the process of describing the workings of the network, in order to render some of these workings visible. Such description, we would argue, is necessary because these workings mostly become 'black boxed' and as such become accepted, or taken for granted, as the way the world is—they gain an "aura of naturalness" as Ciborra and Lanzara (1994) suggest.

[3] A variety of empirical studies have demonstrated the value of this work for the IS discipline such as the work of Lin and Silva (2005), Doherty, Coombs and Loan-Clarke (2006), Bartis and Mitev (2008) and Hsu (2009).

The importance of this co-constitutive interaction (between the social and the material) has become the focus of some recent work in IS and Organisation Studies (see Orlikowski, 2005, 2007; Orlikowski & Scott, 2008; Leonardi, 2011). For example, Leonardi (2011) shows how this interplay, or more precisely imbrication, between the material and the social affords or constrains certain possibilities for action. He suggests that as human actors encounter these constraints or affordances (as part of their historically unfolding practice) they will make choices in the way they will imbricate these agencies to either produce new routines (humans) or new technologies (material), thus producing new sociomaterial imbrications that allows for (or constrains) new forms of action. Thus, he sees a continual interplay in the way imbrications produce affordances and constraints which then produce new possibilities for action which then suggests new possible imbrications, and so forth. It is our view that this work represents a big step forward in taking materiality seriously—thus, imbrications are medium and outcome of ongoing pragmatic action. Our analysis below, although similar in it orientation, has a different intent. We want to highlight the performative outcomes of these imbrications. In particular the performative outcomes that produce agencies in ways that not only support the possibilities for action of the actors but also unexpectedly subvert their intentionalities. Instead of looking at what these imbrications afford or constrain we want to look at what they reveal and hide in their ongoing co-constitution of each other.

In the sections that follow we will describe the imbricated and entangled practices of human and non-human actors in order to show how a certain profound sort of implicit and embedded 'politics' of academic writing, plagiarism and detection emerges. A politics in which some actors are constituted as 'plagiarists' and other not—which is not the intentional outcome of specific actors but the way in which different actors become co-constituted in and through a heterogeneous network of higher educational practices in the UK.

3. Teaching and learning practices in Greek Higher Education

The research for this case was undertaken between 2004 and 2007 and comprised of four visits to Greece, where open ended and semi-structured interviews, focus groups and observations were undertaken across seven Greek Higher Education (HE) institutions. Interviews and focus groups were conducted with academic staff, students and alumni. We undertook 23 interviews with students in Greece, and 3 focus group interviews with students who had recently started postgraduate study in the UK. We also interviewed 14 academic staff in Greece, and undertook 2 interviews with Greek academics working in the UK. Interviews and focus groups typically lasted between 60 and 90 min. The researchers also attended lectures and observed learning and teaching practices *in situ*. Additional interviews were undertaken with a senior member of the Greek Ministry of Education (YPEPTH), the British Council and educational agents involved in recruiting students to study in the UK. In doing the interviews/focus groups we continually pressed the interviewees to speak about what they actually did (and why) rather than what they thought they ought to have done.

The interview and focus group recordings were transcribed and subject to analysis using an iterative hermeneutic process. Initially, the interview transcripts and research diaries were read, annotated, compared and coded into emerging themes. These themes were partly conditioned by our theoretical commitments and partly suggested (or emerged) from the analysis of our data. Examples of themes that emerged were: how they were taught, how assessments were done, how they would prepare for examinations, how they would go about doing writing assessments, their previous experiences in academic writing, how they used sources in writing and preparing for assessments, what they thought the tutors expected from them, and so forth. Analytical themes and sub-themes were refined and reformulated in further follow-up interviews and focus groups. These themes were finally considered and refined in relation to the secondary literature on the Greek HE system—that is the literature available in English. This paper only covers a relatively small portion of the data collected.

Importantly, whilst our empirical research was extensive in both the variety of institutions and the number and range of interviews and observations conducted it is impossible to present the richness and variety of Greek undergraduate education due to space constraints. It is important to note that in the end this is not a study of Greek HE as such, but rather we merely present it as a case example of how culturally situated practices become reinterpreted by a sociomaterial network in a different context. As such the material presented below will by necessity lack the completeness and subtlety that such a study might have provided. Finally, we must emphasise that the data below is not presented for comparative reasons,

nor do we want to make any judgement as to the merits of the UK HE practices as opposed to the Greek HE practices (or *vice versa*). We are rather interested in how the learning and teaching practices are *different* and how this difference conditions the interpretations and practices of all the actors involved in the heterogeneous network of academic writing, plagiarism and algorithmic based plagiarism detection systems—more specifically how these practices tend to constitute Greek students as 'plagiarists' (and others not) once they become situated within a different heterogeneous sociomaterial network.

3.1. Some background to the Greek higher educational context

Greek HE consists of both public and private sector institutions. State run institutions take the form of either Advanced Educational Institutes or Technological Education Institutes (TEI). The former comprise of the better known and longer established universities offering education in most subject areas, whilst TEIs focus on science and technology subjects and are more practically oriented. Currently, undergraduate education at public sector universities is provided free of charge (Papastamatis, 2007), though there are calls for tuition fees and students loans to be introduced (OECD, 2007, 2009).[4] The OECD (2007) has recently called for reform in Greek Higher Education so as to address the high dropout rate, the length of time it takes for undergraduates to complete their studies and the highly centralised nature of Greek Higher Education hindering possibilities for change (p.33).

3.1.1. Centrality of the textbook

Both the literature and our empirical data highlighted the centrality of the textbook in Greek Higher Education (Katsikas, 2009; Tsoukalis, 2006). Students are provided with a free copy of the course textbook (funded by the Ministry of Education) at the start of each semester (Katsikas, 2009; Tsoukalis, 2006). Greek academics are required to write a textbook (in Greek) as part of their tenure agreement. Tsoukalis (2006), an eminent professor at the University of Athens, argues that the provision of a free text book per module is controversial since it may be seen by some as a way to provide extra income to instructors rather than necessarily for good educational aims. Moreover, the authority of the textbook is confirmed as students "know that reading a single text per unit is quite enough to pass the unit" (Garoufallou, Siatri, & Hartley, 2008, p68). Indeed Katsikas (2009) argues that this identification of a subject with the context of a specific textbook is one of the most striking characteristics of Greek Higher Education, noting that: "The content of this textbook provides the material for a reduced syllabus (measured usually in pages), which in turn forms the unique field of the students evaluation regarding the degree of comprehension of the respective subject (p.19)." Another important implication arising from this textbook orientation is that they limit the diversity of knowledge that students are exposed to (Tsoukalis, 2006). This reliance on textbooks can be partially explained by the fact that Greek undergraduate students undertake significantly more modules than their British counterparts.

Whilst this textbook approach tended to dominate in our research, we were also aware that some staff had asked students to find and refer to other sources. These were typically academics that were either active international researchers and/or had spent some time studying and teaching outside of Greece. However, interestingly, when the use of articles to support teaching was discussed with staff and students many suggested that they preferred the reliance on a core textbook. As a Greek Professor explained:

> "*the students are not happy at all with us giving them literature or a bibliography. They are not happy because they … want the simple thing, which is a textbook …it's 150/200/300 pages, you will read it from front to back, and that's it.*"

3.1.2. Examination orientation

The secondary literature as well as our data indicate that assessment primarily takes the form of final examinations leading Katsikas (2009) to characterise Greek universities as being "exam factories"(Papastamatis, 2007). Greek students undertake approximately four or five times more exams than their British counterparts. Further still, until 2007, there was no limit as to the number of retakes that a student can take for each course

[4] Postgraduate education is not free though tuition costs are modest in comparison with other OECD countries (OECD, 2007).

(Katsikas & Dergiades, 2009).[5] This emphasis on exams was explained in part to be a pragmatic response to the poor staff student ratio (OECD, 2007; Tsoukalis, 2006). Our research and the literature suggest that for students to succeed in exams, this requires the "rote memorization of the textbook's content…" (Katsikas, 2009, p.19). Indeed, during lectures students were often made aware of the specific sections or pages of the textbook that lecturers thought important for the examination (Ksanthopoulos, 2005; Dimou, 2008).

Some of the newer academics that had worked overseas claimed that they did not support this over reliance on final examinations, and did provide opportunities for limited coursework assessment. Due to the poor staff student ratio, when coursework was permitted, it typically comprised of group work and report writing rather than individual essays (OECD, 2007; Tsoukalis, 2006). This lack of experience of individual essays was captured by Katsikas (2009:19) who noted: "the assignment of individual written work is a rare practice." Due to this reliance on exams students typically received no or limited formative feedback (Katsikas, 2009, p.19). Moreover, our empirical research also revealed that even when students had submitted coursework, many had received a mark with no or limited formative feedback.

3.1.3. Information literacy

Our research and the literature highlighted the limited referencing requirements in Greek undergraduate education (Korobili & Tilikidou, 2005; Katsikas, 2009), as Katsikas (2009) notes "Greek students are unaware of the concepts of reference sources and related literature."Additionally, whilst recent changes to Greek libraries (especially since 2002) have provided access to electronic journals (Xenidou-Dervou, 2003), as the language of instruction is Greek, referring to other sources (outside of the textbook) is difficult as there are limited numbers of academic publications written in Greek. This is compounded by Greek academics not publishing as many articles relative to their OECD counterparts (OECD, 2007, p.105). Moreover, the centrality of the textbook also meant that Greek university libraries were generally poorly stocked (Keller, 1993; Raptis & Sitas, 1996).

Our empirical work and the literature suggest that this new level of access to electronic sources – through the Hellenic Academic Libraries Link – has not yet been internalised in educational practice in any significant way. For example, Korobili and Tilikidou's (2005) study of information literacy in a TEI's Marketing Department found that a low percentage of students used the library's e-resources. Korobili, Malliari, and Christodoulou (2009) also found that a good percentage of staff at this Greek higher educational institution "was not acquainted with electronic sources (p.341)" and that faculty tended not to motivate students to use library sources (Korobili & Tilikidou, 2005; Birk and Karageorgiou (1993). This lack of experience with regard to information literacy could be explained as being due to the reliance on textbooks and also the fact that most Greek faculty do not require students to undertake individual coursework (Korobili & Tilikidou, 2005). Finally, Korobili et al (2009) note that there has been a paucity of the literature pertaining to the information literacy in Greek universities.

3.1.4. Lecture oriented

Our empirical work highlighted that teaching typically comprises of lecturing in large amphitheatres (Katsikas, 2009). Whilst undergraduate class sizes were large, typically between 100 and 400 students would attend a lecture, numbers often dropped off over the duration of the module. One explanation provided for this was that students would tend to attend the first few and the final few lectures so as to gain a familiarity with the course content, structure and assessment requirements. Some of our interviewees claimed that as the lecture closely followed the textbook (Katsikas, 2009), students would ascertain which textbook chapters and sections were to be covered, and consequently what they needed to revise for the final exam. Katsikas's (2009, p.20) study concurred with this noting that "students realise quickly that there is no real benefit to attending lectures except perhaps for guessing the exam questions."

There have been a number of recent changes to the Greek education system that may signal transformation. For example, in 2005, the Greek government created the Hellenic Quality Assurance Agency (OECD, 2010). This has recently resulted in some internal and external evaluations. The implications of this change are still not clear. Further limits have been placed on the duration of

[5] Katsikas and Dergiades (2009) claim that as very few students had taken more than 8 years (3%) to complete their studies and second University Rectors were unsure as to whether it would be possible to implement the reforms, this change seems likely to have little impact. Further, students effected by these reforms will not reach their eight year limit until 2016.

undergraduate study, and entry requirements have been raised with the aim of reducing the dropout rates of low performing students (OECD, 2010). In sum it is important to note that the culturally situated learning and teaching practices in Greek HE tend to constitute teaching/learning and the learner in a particular way. *In other words the typical undergraduate Greek student has a particular culturally situated understanding of what it means to demonstrate that they 'know' and how such knowledge ought to be expressed*. We should state very clearly that we are not claiming that this is necessarily true for all Greek students. Clearly many of them might be different and some of them are most certainly reflexively aware of their own practices. Nevertheless, we would claim that given their previous participation in the Greek HE system a large number of them would tend to have taken for granted understandings of what it means to know and how evidence of such knowledge needs to be demonstrated. Given such taken for granted understandings and associated practices, one might ask how these understandings and practices would transfer to a HE context where there are very different (also often taken for granted) understandings of how to demonstrate that one 'knows' and how such knowledge ought to be expressed. Before we turn to this discussion it would be useful to get a better understanding of our other key non-human actor, the so-called plagiarism detection systems.

4. Algorithms and the detection of plagiarism

4.1. The detection algorithm

How does a software algorithm go about detecting text copies? Unfortunately many of the detection systems (such as Turnitin) are proprietary software and therefore not available for analysis. However, there is a publically available algorithm which we can consider as a basis to understand the principle of how these algorithms tend to work; it is an algorithm called 'winnowing' (Schleimer, Wilkerson, & Aiken, 2003).[6]

Winnowing, like many other algorithms, makes a *digital fingerprint* of a document which it then uses to compare documents against each other. The fingerprint is a small and compact *numerical* representation of the content of the document that can serve as a basis for determining correspondence between two documents (or parts of it). A fingerprint is created by: (1) removing irrelevant information from text (white space and punctuation) to create a continuous character string, (2)Chunking this long string of text into equal blocks (of say X characters); (3) converting these chunks into numerical values (using a hash function) (4) Taking a sample of consecutive hashes from the string of all the hashes (at least one from each window, where window size is a parameter), and store this as the digital fingerprint of the document.

It is in step 4 where most algorithms differ. There are a variety of techniques for determining which hashes to keep as the document fingerprint (see also Brin, Davis, & Garcıa-Molina, 1995). The ratio between the total population of hashes and the sample selected for the fingerprint is called the *density* of the fingerprint. As long as the algorithm ensures that it takes at least one unique hash from each window (of say 100 characters) for the fingerprint it will be able to detect most copied fragments. Most sentences in this paper vary between 50 and 300 characters. The vast majority is over 100. Thus, any partial copy of a document – greater than 100 characters, which is a typical phrase – will map onto a part of the fingerprint, making it possible to identify the part as belonging to the document identified by the fingerprint. *The key point to remember is that the probability to be detected will increase the longer the sequence of characters from the source document is retained.* If a writer can break up the character sequence by rewriting the sentences sufficiently they will remain undetected. However, such rewriting will require quite a bit of linguistic skill, often more than the non-native speaker can muster.

Of course there may also be other reasons (other than fragment size) why a copy is not detected. It might be that the document that the writer has taken the text from is not in the database of the detection system—i.e. it has not been indexed by the system. It is clearly not possible to index every possible text, especially if these texts are not in a readable electronic form (such as, for example, books, and PDF image files). Some texts on the internet are also behind passwords (not in the publically accessible web) such as some academic journals that do not have agreements with detection services such as Turnitin. Thus, to not

[6] Also refer to Heintze (1996) and Bao et al. (2006) for alternative methods.

be detected does not mean that the text was not copied from another source. It may simply mean that the copied fragments of texts in the document have been sufficiently modified or that the source might not be in the database of the detection service. Likewise, to be detected does not necessarily mean that the writer has plagiarised as we will discuss below.

4.2. The implementation of plagiarism detection systems by UK universities

One of the most widely used systems for copy detection in UK universities is Turnitin. They claim that they cover seven million students in eighty five countries. Indeed to a large degree Turnitin has become a default service for copy detection. In the UK this is especially true since the service is provided through a JISC agreement covering most HE institutions. In many institutions so-called plagiarism detection has become part of the assessment submission process (which is often done by an administrator even before the academic is involved)—in fact, they are also increasingly embedded in e-learning systems such as Blackboard for example. Typically, the assessments are submitted in a batch to the detection service and a selection of assessments – based on criteria such as more than x% copied material, or the top x cases – are identified for further more detailed scrutiny, usually by an academic member of staff.

We have also found in our fieldwork (Hayes & Introna, 2005) that there were significant variations in the way Turnitin reports are interpreted and the interpretation of what constitutes plagiarism. In some departments there were strict legalistic interpretations of plagiarism where any copying is taken as plagiarism and the only issue is the extent. In other departments a more contextual interpretation were used. For example, they would look at where the copied text is in the assessment, how central is it to the argument of the paper? Does it come from one source or many sources? Was it referenced or not? In this vacuum of uncertainty and with the increasing pressure on universities to deal with the 'rise in plagiarism' the automatic detection of copied text will most certainly remain high on the agenda. But what is it that these systems detect and what do they reveal about us and our assumptions about learning and teaching?

5. On the imbrication of Greek students and plagiarism detection systems

As outlined in the introduction, the focus of this paper is to problematise, open up and reveal the imbrications between a specific culturally situated human actor (the Greek student) and a specific culturally situated non-human actor (the plagiarism detection system)—i.e. how they encounter, interpret and constitute *each other* within the context of the UK Higher Education (HE) system. As suggested above, when human and non-human actors engage/encounter each other they tend to already hold assumptions about the 'other', in front of them, so to speak. These interactions (as we might describe them) presuppose a prior intra-action as argued by Barad (2003). *In other words, through their assumptions, pre-understanding, interpretative frames,* etc. *they already constitute (or enact) the other as a particular sort of entity, rather than another.* Thus, what we see when human and non-human actors encounter (or more precisely constitute) each other, is that certain differences (such as inappropriate interpretive frames) are rendered visible whilst simultaneously rendering others invisible.

Based on our Greek case example we will specifically focus on how the delegation of plagiarism detection to a technical actor produces a particular set of agencies and intentionalities (a politics one might say) which unintentionally and unexpectedly conspires to constitute some students as plagiarists (who are not) and others as not (who are).We suggest that this is best explored by looking exactly at what is rendered visible, and what invisible, in such imbrications. Table 1 suggests some of these which we will discuss further. Before proceeding we want to note that although we focus on Greek students, some aspects

Table 1
Rendering differences visible and invisible.

Analytical theme	Dimension
Rendering differences visible	• Assumptions about appropriate writing practices, learning and assessment • Constituting and reconstituting plagiarism
Rendering differences invisible	• The delegation and routinising of detection • Recovering the assumptions of designers

of the discussion provided is also likely to be relevant to other international students as well as some UK students.

5.1. Imbrications and the rendering visible of difference

What assumptions does the plagiarism detection system (PDS) hold of writing and writing practices and what does it render visible? The answer to this question is best explored by looking at the way the learning and writing practices of Greek students, outlined above, are framed by the PDS. We will suggest that the PDS does not only detect some textual copies, it also renders visible – especially for the mobile student population – substantial differences in understandings of what constitutes learning and knowledge production (and demonstration).

In many countries such as the UK, in the humanities and the social sciences the academic essay has for a long time been seen as the standard bearer of the quality of thought and learning of the student (Lea & Street, 1998; Lea & Stierer, 2000; Read, Francis, & Robson, 2001). If this is the case how do students go about writing them? In our fieldwork we discovered that the electronic writing practices of most contemporary students – who are increasingly natives to the digital world – are very different from the writing practices of hand written or even typewritten texts (Heim, 1987). In electronically mediated reading and writing practices writers tend to pick up exemplary text fragments as they read electronic source texts. These fragments are 'cut' from the original source and collected (often under headings or themes) for later use (Whitley & Grous, 2009). Thus, electronic writing tends to start with text fragments rather than with a blank page/screen. The key skill is to draw upon (or reuse) these fragments to argue or make your point, writing over them and knitting them together as one proceeds. The UK student – usually a native speaker in a UK university – will tend to paraphrase the text fragments and weave them together with their own writing in such a way that all of the text eventually becomes written in the same 'voice' (Howard, 1995). They would tend to cite their sources extensively as they know that this demonstrates their research skills, reading skills and knowledge of the literature. Such citing will also signal to the tutor what informed their ideas and arguments. In other words, for them, using and citing diverse sources is a way of demonstrating their knowledge, understanding and learning—i.e. not primarily to avoid charges of plagiarism.

It ought to be clear from our outline of the Greek HE context that such academic writing, and the use of a variety of academic sources in support of it, is not part of what the typical undergraduate Greek student sees as learning and knowledge production/demonstration. Moreover even if they are given explicit instruction on academic writing and information literacy, as part of their course in the UK (something they were unlikely to have been provided with in Greece), it will still not necessarily provide them with the required skills and practices to speak in the 'academic language'[7]—especially since they often need to do so within weeks of starting their course. More importantly, they will tend not do it as they do not frame learning and knowledge demonstration in that way. One common way in which Greek students would seek to cope with this lack of familiarity with academic writing in the UK (i.e. as novices to this practice) is that they would tend to retain significant chunks of text from their collected text fragments. Indeed our research has shown that this is a dominant strategy used by students to cope with their uncertainty—uncertainty with regard to their understanding of the material, their lack of confidence in their use of English and/or the academic phraseology relevant to a particular discipline they are studying (Howard, 1993, 1995; Read et al., 2001).

As we have already explained, the probability of being detected is dependent on the decision by its designers, as to the size of the fragment (the number of consecutive characters) one retains from the original text. In this sense, the algorithm is an important non-human actor, which has specific assumptions about detecting, writing and assessment. To take one example. The location, within the fragment, of the consecutive string is very important due to the sampling window. In experiments with Turnitin it was shown that if one would change one word in a sentence at the right place—often between the 7th and 14th word in the sentence—then Turnitin would tend not to detect it even if all the rest of the sentence remained exactly the same (Hayes & Introna, 2005). Thus, it was shown to be possible to submit a fragment of 300 words by simply changing approximately every 7th to 14th word and remain undetected. In contrast Turnitin easily detected a small fragment of 26 consecutive unchanged words. Given these assumptions we

[7] Roig (2001) showed in his study that even experienced academics tend to write with fragments when confronted with difficult material.

can imagine what would happen when the algorithm encounters the writing practices of Greek students. For many Greek students retaining sufficiently long fragments makes sense, after all they are very familiar with learning by reciting and memorising a canonical text. We would expect them to view retaining verbatim some of the source text (especially those written by their lecturer) not only as a legitimate practice, but also as desirable to demonstrate ones knowledge of the subject area (Shi, 2004). Further, still, finding themselves in an unfamiliar position of not doing well, they are likely to return to what they are good at and take as legitimate, they copy/recite and thus retain long strings of consecutive characters (fragments) from the research papers they read and thus be detected by the system.[8] Significantly the ease of copying and pasting between documents and electronic sources (which electronic texts afford) may further increase the likelihood of Greek students retaining such fragments of text in their writing. Thus, the system is simultaneously making possible the copying of fragments from electronic sources into a word processing document, the electronic submission of coursework to a PDS, and the detection of fragments of text that are retained from the original source. When the PDS detects textual copies what does it detect? We would argue that the algorithm may or may not detect plagiarism. However, more importantly, we would suggest that the imbrication of the human and the non-human renders visible differences in assumptions by all the actors involved. Indeed it renders visible a shift from one particular regime of knowledge (which values reciting, repetition and memorisation) to a new regime of knowledge (which values criticality, originality and independence).

Another unexpected outcome in relation to the visibility of the sociomaterial imbrication is the manner in which the act of plagiarising becomes institutionally framed (and reframed). What we see is that the debate on what plagiarism is (or is not) now becomes reconstituted as a debate about % of copied text, as shown in the Turnitin originality report. Furthermore, disciplinary committees increasingly expect cases to be supported by a Turnitin report, thereby unwittingly constituting Turnitin as the authority as to what plagiarism is. Likewise, students increasingly defend themselves against the claims of plagiarism by suggesting that Turnitin did not detect anything, as is clear from this comment on the Plagiarism discussion list:

> There is a noticeable increase in students who believe that “passing” the Turnitin “test” proves that they haven't plagiarised and they use Turnitin to ensure that they have not plagiarised accidentally. In some cases, this shows a lack of knowledge of what plagiarism is — they don't know if they have plagiarised or not, but if Turnitin says it is OK, then it must be. For some, it is pushing the drive away from not plagiarising to not getting a high Turnitin score, without truly understanding what the scores mean.

With such a framing of academic writing, Greek students, who may not fully appreciate what academic writing is and seeks to achieve, may reframe academic writing as ‘passing’ the Tunitin test. This shifts the attention away from learning to a technically mediated ‘game’ between the tutor, the technical actor and the student.[9] There are many more examples which we can discuss. For example the way Turnitin makes electronic writing practices visible, which in turn raises the question as to the appropriateness of the academic essay (which emerged in the 16th century in the university context) as a form of assessment. Or, the fact that Turnitin turns essays into a commodity value which can fetch high prices on the open market because they are guaranteed to be ‘Turnitin clean’ or ‘detection free.’ *However, our central point is that in the sociomaterial imbrication many of the actors become reconstituted in unexpected ways due to the interpretive frames (assumptions, values,* etc.*) that they hold of each other.*

5.2. Imbrications and the rendering of difference as invisible

Whilst thenon-human actor (the PDS) rendered visible these different practices and assumptions, the PDS can also appear inconspicuous and invisible by embedding itself in the routinised taken for granted

[8] Importantly, we do draw a distinction between those students when faced with the enormous challenges where almost everything is new just copy and paste large chunks of text from a limited number of sources and hope they will not be detected rather than those who are seeking to assimilate the new requirements, but are detected as having copied fragments of text from many different sources.

[9] It is worth noting that most publically funded Greek Universities tend not to use Turnitin. This is in spite of the fact that Turnitin can deal with the Greek alphabet.

procedures and practices. We first examine this invisibility with regard to the delegation to, and routinisation of, the use of the technical actor, and second with regard to the assumptions of its designers, and how these largely invisible assumptions are important in shaping our understandings of what constitutes plagiarism.

The invisibility of the delegation to, and routinisation of, the so-called plagiarism detection practice becomes evident when this significant technical actor becomes embedded as an unquestioned part of the coursework submission process, and integrated into e-learning systems (such as Blackboard). Proponents suggest that such a role is important for mainly two reasons. First, they argue that by using Turnitin for all submitted work they demonstrate to the students (and other stakeholders) that they are 'serious' about academic integrity. This they suggest is necessary to guarantee the quality and standard of their degrees. It is also necessary to use automated 'tools' due to significant changes in staff/student ratios—the result of the massive expansion of HE in recent years. Second, they argue that by subjecting all essays to this 'technical' scrutiny we are treating students fairly. Thus, well-meaning lecturers in the UK often argue that when manually reading the scripts, it is easier to identify 'plagiarism' (or copying) in coursework of those written by students whose first language is not English, as the copied text is in a better English than the text the student has written themselves, or there is a distinct change of 'voice'. Consequently, they propose that automatic copy detection (such as Turnitin) is a neutral and fairer solution—for them it is just a 'tool' for detecting which they see as being 'neutral' and thus oblivious to where the student comes from. What are the implications for such a delegated and routine use of PDS for Greek students?

The typical practice for using systems such as Turnitin in a UK university is that administrators will typically submit the essays to the PDS (or it is included as part of the electronic submission process). They would then review the 'originality report' and highlight the top x% of cases as being especially relevant for the course leader or the academic malpractice officer to scrutinise. The Turnitin 'traffic light' categories are often used for this purpose.[10] This has important implications in the context of Greek students. If their writing practices are constituted, as we have described above, then there is a high likelihood that they would be the ones identified as the top x% of cases. Their likelihood of being in the top x% of students investigated is increased as native speakers are more likely to be able to "write over" the fragments they copy so as to remain undetected—i.e. fall below the line or threshold of scrutiny. Importantly, even though they are not considered worthy of scrutiny, they may be copying the ideas, structure and argument from just one source without attribution (i.e. plagiarising), whilst the copied text of Greek students may comprise of an original argument constructed from many small fragments from multiple sources throughout the text—a text which one could argue does not reflect cheating but rather a Greek student learning how to write for an assessment in a very different context of learning and teaching. Clearly, this delegated and routinised use of so called plagiarism detection systems has some important implications with regard to the fairness and learning of Greek students. Such a paradoxical and unfair constitution of the Greek students as a plagiarist (and the other students as legitimate scholars) is not what the designers intended, nor necessarily what other influential stakeholders in higher education institutions had in mind when they advocated their use. Nevertheless, in the imbrications of the technical and the social the constitutive framing flows in many unexpected ways.

A second dimension that our case highlighted with regard to the inconspicuous aspects of technology is the importance of recovering and de-scribing the assumptions of the designers of the non-human actor. Clearly, it seems fair to assume that such technologies were not designed with such specific culturally situated actors in mind (Walsham & Sahay, 1999). Nevertheless, that does not mean that these technologies do not embody values, assumptions, etc.—i.e. that they are themselves already culturally situated actors. As is clear from our discussion above, the designers of the detection algorithm equate plagiarism with exact copies of text as specific expressions of ideas. This is a very particular cultural historical understanding of originality and authorship. It could be argued that, under the sway of the 'possessive individualism' of the Romantic age, and particularly the development of copyright law, the author becomes established as the original source (and owner) of the text (Jaszi, 1991; McFarland, 1974). With authorship framed in this way the idea of plagiarism shifts from its classical framing as a transgression of attribution (not composition) to being understood as a crime of deception—which is practised by copying the *exact expressions* of the 'original author' (Terry, 2007; Lindey, 1952). Thus, in the contemporary age of intellectual property, and within the context of copyright law,

[10] The Tunitin traffic light categories (in the Originality Report) are defined as follows: Blue: less than 20 matching words; Green: 0–24% matching text; Yellow: 25–49% matching text; Orange: 50–74% matching text; Red: 75–100% matching text.

plagiarism is mostly presented as the copying of another's words (exact expressions) and presenting them as one's own—in this interpretation of authorship ideas cannot be owned but expressions can. Within such a framing of plagiarism it seems natural to have an algorithm that detects copies (or the similarity) between texts and call it a 'plagiarism' detection system.

How then does this particular interpretation of plagiarism, as framed by the non-human actor, play itself out in the sociomaterial imbrication relevant to the mobility of Greek students? How does it constitute these culturally situated human actors? The key point to remember is that the probability to be detected will increase the longer the sequence of characters from the source document that is retained. If a writer can break up the sequence by rewriting the sentences sufficiently, and thus breaking up the number of consecutive characters, they will tend to remain undetected (Hayes & Introna, 2005). However, such rewriting will require quite a bit of linguistic skill, often more than the non-native speaker can muster. Clearly, if the basis of such more advanced linguistic skills is a familiarity with the English language, argumentation and critical analysis, as well as a grasp of the subject area, then Greek students are likely to be detected disproportionately to those native speakers who are familiar with the educational practices in the UK. However, for us the key point is that to not be detected does not mean that the text was not plagiarised. It may simply mean that the copied fragments of texts in the document have been sufficiently modified, or the source might not be in the database of the detection service. There may be many reasons why a copied text would not be in the Turnitin database such as documents in image PDF format, documents behind passwords, sites that exclude the Turnitin indexing softbot, and so forth. Likewise, to be detected does not necessarily mean that the writer has plagiarised.

More concretely, with systems such as Turnitin, as is already apparent, it is important to highlight that such systems detect copies of text not plagiarism, as is generally understood. In this sense a better term for the technical actor would be a *copy detection system*. By recovering and questioning the assumptions of the non-human actor (the PDS) it helps us open up and reveal what these systems are, what they do, and how this matters within a particular cultural historical understanding of pedagogical practice (Pennycook, 2007). By doing this it allows us to better appreciate the many reasons why copies of text fragments may occur in the assessments of students—and what this might mean for learning and teaching practice. Thus, we argue that as a technical actor becomes embedded and taken for granted, gaining an "aura of naturalness", many alternative possibilities for understanding—why there are copied text in the essays of students, for example—remain unrecognised and invisible, and many practices and expectations become and remain unquestioned. More broadly, we argue that through the uncritical adoption of PDS (such as Turnitin) a particular view of plagiarism is becoming institutionalised. By accepting copy detection algorithms, as the de facto standard, we are implicitly legitimising the view or assumption of the technical actor that copying is equal to plagiarism, as was mentioned above.

Without undertaking such critical questioning, our case indicated that the PDS framed how we are to understand such differences—that is, as instances of plagiarism rather than as difference in understanding what it means to show that you know, etc. Indeed, as currently constituted there seems to be an unintentional conspiracy (between human and non-human actors) to constitute some students as plagiarists (who are not) and others as not (who are). Further as their base of users expands, this labelling of copy detection systems as being plagiarism detection systems will continue to strengthen and legitimate this particular view. In the sociomaterial network of plagiarism detection the algorithms are becoming very powerful actors (intentionally or unintentionally). The question is whether we really understand and appreciate the consequences of the intentional and unintentional political programme of this sociomaterial network?

6. Some conclusions and implications

We started this paper with the proposition of Barad (2003) that in our thinking about technology we tend to think about the 'human side' as being significant (language, discourse, culture, etc.) but we tend to forget that 'matter' (the materially constituted technology) also really matters. We proposed that we correct this human-centric perspective with a constructivist ontology (drawing of the work of Latour, for example) in which the social and the material are fundamentally co-constitutive. We indicated that the work of Ciborra (formative context) and Orlikowski (technological frames) need to be, in a sense, reinterpreted to allow for an understanding that we do not only constitute technology (through our framing of them) they also constitute

us (through their framing of us and our practices). In our imbrications with technology we are their constitutive context as much as they are our constitutive context.

In the context of Greek student mobility, we illustrated this co-constitutive imbrication by looking at the manner in which a specific human actor (the Greek student) and a specific non-human actor (the plagiarism detection system) encounter, interpret and constitute *each other* within the context of the UK Higher Education (HE) system. We showed that in this imbrication of the social and the technical some assumptions and practices are rendered visible and others are rendered inconspicuous, often with very significant implications for the actors involved. For example in this co-constitutive relation the writing practices of Greek students are often unfairly constituted as 'plagiaristic' (which they mostly are not). Moreover, we showed that the delegation to, and routinisation of, detection to a non-human actor effectively institutionalises a view of plagiarism which equates copying of text to plagiarism. In this framing many alternative possibilities for understanding how text fragments enter the writing of students remain unrecognised and invisible.

We would argue that our case study is an example of a more general claim about the historically culturally situated nature of all sociomaterial imbrications. Information systems literature has highlighted how often technologies embed a series of values that may contrast, conflict or even contradict the values and assumptions in a specific context of use. For example, Walsham and Sahay (1999) showed that geographic information systems contain a series of "Western" values embedded in them (e.g. use of maps to represent the territory), which may contrast with those values held across different developing countries (Puri, 2007; Miscione, 2007). Alternatively, when ERP systems are implemented in the public sector they are criticised as reflecting a specific "ideology of the private sector" (Allen & Kern, 2001).The more general point that this paper wants to make is that *in sociomaterial imbrications intentionalities (agencies) emerge that cannot be reduced to any actor as such.* They are the performative outcome of the sociomaterial nexus. This is a very important conclusion with many significant implications for those who design and implement information systems. These IS design and implementation projects often desire to implement a particular political programme—whether it is efficiency, communication, coordination or any other strategic intention. What our research suggests is that such a programme is not 'in the hands' of any single actor. Furthermore, that any such programmes may have many unintentional outcomes that may be contradictory or even subvert the very intention the programme supposes. We are not just saying that implementation may lead to unintended consequences (this is a well-established fact). What we are saying is that the actual identities of the actors (in the network) cannot be reduced to their attributes, roles or functions but are emergent in the ongoing co-constitutive relation between all other human and non-human actors—i.e. it cannot be reduced to simple cause and effect relations which can then become the focus for intervention.

More specifically the manner in which such sociomaterial imbrications are historically and culturally situated is fundamental—the issues is not one of better or worse but of difference. No actor (human or non-human) in the network has a stable identity that transcends the network. Actors are what they are in and through a network. This means that if we transfer the technological actor from one socio-cultural context to another, even if they seem the same they may in fact become constituted in the new network as being very different—not in its functions, attributes and roles as such but in the assumptions that other actors in the network have of it, and the way the other actors interpret it and respond to it. In our case the assumptions of what plagiarism is has become embedded in the code of the algorithms. Lecturers have come to accept these assumptions, implicitly or explicitly, as they draw on this actor to enact detection. In accepting this actor (and its assumptions) they, in and through the PDS, have unintentionally constituted Greek students legitimate learning practices as plagiaristic. A powerful political script has emerged and there is no obvious 'author' and no simple intervention to change it.

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