KNOWLEDGE CREATION IN VIRTUAL TEAMS

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Abstract

The paper aims to contribute to a better understanding of knowledge creation in a context not researched extensively so far, the virtual context. Claiming that knowledge is connected to the context in which is created, the paper argues that knowledge creation could be differentiated by the specific characteristics of virtuality. The process of knowledge creation is conceptualised using a theoretical framework. The notion of virtuality is discussed and juxtaposed with physicality. The central role of mediated interaction is identified as the primary mean of communicating and collaborating, which replaces face-to-face interaction. A systematic comparison between direct and mediated communication is offered to highlight the key issues that affect knowledge creation. The paper focuses on the organizational context of virtual teams to describe the specific characteristics of virtual teams in comparison with face-to-face teams with regards to knowledge creation. The basic contribution of the paper is that it addresses a key issue that organizations are facing today, knowledge creation in a virtual context.

Keywords: Knowledge Creation, Mediational Means, Social Interaction, Constructionism.

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1. Introduction

Knowledge becomes critical to people in the emerging information economy, since it is recognized as one of the main factors of economic growth and prosperity (Teece, 1998). The resource-based theory of the firm considers knowledge creation very important, since it is thought to provide the primary source of sustainable competitive advantage for firms (Drucker, 1993). The research on knowledge creation process conducted so far has attempted to provide an understanding of how knowledge is created in firms, where humans communicate and collaborate, sharing the same time and place. However, the widespread use of Information and Communication Technologies (ICTs) is changing the pattern of work, which is increasingly becoming geographically dispersed and asynchronous (Montoya-Weiss et al., 2001). As this transformation of work has recently started, limited research has been conducted, arguably, on knowledge creation in dispersed teams (virtual), either in a single organization or across organizations, that do not share the same physical environment, but collaborate and communicate, using mainly ICTs (Montoya-Weiss et al., 2001:1259). Research conducted so far in relation to ICTs has mainly concentrated on opportunities and limitations of mediated communication as compared with face-to-face communication.

The purpose of the paper is to conceptualise knowledge creation and explore how the specific characteristics of virtuality could differentiate knowledge creation. It does so by pulling together literature from Psychology, Sociology, Computer Science and Management Science. The first part of the paper reviews the literature on knowledge creation while the second part of the paper attempts to conceptualise virtuality by offering a conceptual framework that juxtaposes virtuality with physicality. The two bodies of literature are then put together, giving rise to the research question "How is knowledge created in a virtual context?". It is argued that the salient features of virtuality namely: lack of social presence in a shared context, different front and back regions, elimination of specific types of social cues being transmitted, result in individuals having greater difficulty in expressing themselves and understanding the expressions of others. While agreeing that the process of constantly understanding and self-understanding is a source of knowledge creation (Thompson, 1995; cf. Foster and Meech, 1995), the paper argues that the process of knowledge creation takes different characteristics in a virtual context and that theories of knowledge creation must recognise these. The paper brings the argument to an organizational setting that of virtual teams and describes the specific characteristics of virtual teams.

2. Knowledge Creation

The aim of this section is to offer a conceptual framework of knowledge creation process. The framework acts as a tool to compare and contrast different perspectives within various disciplines, namely Psychology, Sociology, Computer Science and Management Science in order to understand thoroughly knowledge creation. It is considered that integrating theories from broader schools of thought rather than focusing on management science studies will enhance a thorough understanding of knowledge creation.

The framework could not be developed without a broad definition of knowledge creation. Considering that, knowledge creation can be broadly conceptualised as a process that presupposes the existence of a knowing subject that uses language in order to understand itself and the world within which he/she interacts. Bearing in mind that broad definition, the following dimensions/categories could be identified:

- ❑ Knowledge
    - ▪ Types of knowledge
    - ▪ Locus of knowledge
    - ▪ Validation of knowledge
- ❑ Knowing Subject
- ❑ The world
- ❑ Language

Three main broad perspectives have been identified with regards to knowledge creation. The first one considers knowledge creation as external behaviour; the second one considers knowledge creation as internal cognitive process while the third one regards knowledge creation as social interaction between individuals in a specific context that marries internal and external processes.

The rational that lies below the selection of these specific schools of thought is that despite offering distinctive and controversial ways of understanding knowledge and knowledge creation, at the same time each of the theoretical perspectives provides valuable insights for understanding the phenomenon. Following a historical path, the paper reveals how the initial focus on behaviourism led to a conceptualisation of knowledge creation as external behaviour. While the perspective offered a scientific study of the phenomenon, due to the rigid exclusion of inner mental processes, was soon dominated by cognitivism a perspective that moved to the other extreme and

focused solely on internal cognitive processes to study knowledge creation. Cognitivism offered an interesting study of the human mind and with the development of information technology (IT) was closely connected to the mainstream management literature but its sole focus on cognitive processes could contribute merely to an understanding of knowledge creation and thorough conceptualisation of the phenomenon. What was still missing, was a theoretical perspective that could recognize the importance of the relationship between mind-body, subject-world, collective-individual. The necessity for such a perspective led to the development of the third perspective that comprehends theories on knowledge creation that give emphasis to both external behaviour and internal cognitive processes. In addition to that emphasis is given to the importance of social context, language and human interaction.

Having previewed the three perspectives, each school of thought is analysed in the following sections using the proposed conceptual framework. The first two perspectives, behaviourism and cognitivism respectively, are analysed briefly as the aim of the paper is to provide an understanding of knowledge creation through the lenses of these schools of thought and emphasize their limitations in order to explore extensively theories within the third school of thought, constructionism, which forms the theoretical basis for the paper.

2.1. Knowledge Creation as Behaviour

In the 1960s, knowledge creation was studied and conceptualised by the school of thought of behaviourism, which was dominating psychology at the time, as an external reflexive process that generated behaviour in response to various stimuli that was appropriate to environmental circumstances through the mind's information-processing programs (Fransella, 1990). Behaviour was considered to be a particular kind of knowledge that was explicit, objective and validated through rigid scientific criteria posed by various sciences (Popper, 1972; Radnitzky and Bartley, 1987). Using principles from the theory of evolution, the human mind was conceived to be a set of numerous information-processing machines that consisted of cells, primarily neurons and their supporting structures that were specialized, by natural selection, to solve adaptive problems. Natural selection was considered necessary in an environment from a Darwinian point of view, because it was not possible for all creatures to survive and some varieties had to do better than others (Blackmore, 1999). Following the Darwinian theory of evolution that despite accepting the mutual interaction between

mind and body, it viewed the two entities as distinct, the knowing subject was seen within this school of thought as a distinct entity trying to understand and cope with the external world (Vollmer, 1987; Wächtershäuser, 1987; Plotkin, 1997). Language was not given emphasis and appeared to be missing in the studies of knowledge creation within this theoretical perspective.

Internal mental processes appeared to be recognized but were difficult to observe and study thus excluded from Psychology at the time. It was Kelly, in 1955, who suggested that knowledge creation involved not only behaving but thinking as well. Kelly suggested that by studying the personal constructs evolved with the body and mind, one might come to understand others and him/herself in psychological terms, and interpret the real objective world that existed beyond oneself. Kelly's ideas are thought to have introduced essentially the cognitive science (Fransella, 1990).

2.2. Knowledge Creation as Cognitive Process

Following Kelly, in the late 1960s the first interpreting models of internal mental states were presented as Psychology borrowed theories from three different scientific areas: computer science, science of information and linguistics (Kalantzi, 1999). Using the analogy of computers, knowledge creation was considered to be the result of inputting, processing and outputting information from/to the external environment upon shaped cognitive processes in the same way like a programmed computer until a mental model was built up that represented the 'real world' (Sokolowski, 1988; Dreyfus and Dreyfus, 1990). This perspective was based on the assumption that knowledge was information representing a pregiven world.

Knowledge was considered as explicit and objective, as either 'true' or 'false'. It could be easily encoded, stored and transmitted (Von Krogh, 1998). Its locus resided on the individual level, in the brain and bodily skills of the individual and could be validated through the development of scientific laws. The knowledge subject was considered to be outside the external world, a world that consisted of logically independent atomic facts that did not depend on the interpretation of any person (Wittgenstein, 1960; Winograd and Flores, 1987; Boden, 1990). Knowledge could be called upon for use in reasoning and could be translated into language, which was considered to be a system of abstract symbols, composed into sentences that stood for things in the world and represented it truly or falsely (Bruner, 1986; Winograd and Flores, 1987).

This view was associated in management studies with Simon (1977), who contributed to the consideration of knowledge in 1970s and 1980s, as an objective commodity that could be transferred easily within and between organizations. AI scientists assumed that the essential knowledge of a profession (e.g. medical, legal, etc.) could be coded into a computer package, which led to the development of expert systems (Penrose, 1989).

Philosophically, this perspective had its roots on the tradition of cognitivism (Descartes, Spinoza, Leibniz), and considered knowledge as an objective representation of the external world (Winograd and Flores, 1987). Philosophy, in contrast to psychology was always concerned with the study of cognitive mechanisms. The objective physical world and the subjective mental world of one's thought and feelings were considered to be two separate phenomena (ibid., 1987). Descartes described the mind as a mirror that could reflect the world, when creating knowledge. He believed that all knowledge was thought and was created from prior thought (Munz, 1987).

The ideas of studying the individual and the environment as two separate sets, as well as considering that the mind could mirror the world objectively had already been criticised in the 1970s when the object of study became the continuous interaction between the knowing subject and the world as a united system, which could influence behaviour through cognition in relation to external stimuli. Hull (1973) borrowing ideas from cognitive psychology and behaviourism and drawing on Kelly's ideas suggested the existence of an intermediate variable between stimuli (S) and response (R), cognition (C) (S→C→R). Based on that, Bandura (1977) claimed knowledge creation was a cognitive transforming process of experiences, dependent on internal prompts, emotions and complex cognitive schemas. Knowledge creation became a pattern of behaviour, relevant to the functioning of the person in its world based on cognition.

Harré and Second (1972) emphasized an important parameter still missing from that perspective, the social context. Until that time, the personal aspect, the experience of the individual and the context in which knowledge was created had been ignored. Emphasis was then starting to be given to the importance of social interaction and the power of everyday language, which led, arguably, to the development of a more sociological perspective, presented in the following section.

2.3 Knowledge Creation as Social Interaction

This section offers an understanding of knowledge creation through the lenses of constructionism and also justifies the appropriateness of this perspective to form the theoretical bedrock for the paper. Considering the developed framework in section 2, knowledge creation needs to be conceptualised, bearing in mind the following dimensions, namely knowledge, knowing subject, the world, locus of knowledge, types of knowledge, validation of knowledge and language.

A definition of knowledge within this perspective could be borrowed from Davenport et al. (1998) who define knowledge as information combined with experience, context, interpretation and reflection. Knowledge or rather knowing is viewed as a social construct, the result of practice, interpretation and linguistic behaviour, dependent on previous experience of the interpreter and on the context it is situated. The idea that knowledge can objectively represent a pregiven world, either truly or falsely, is criticised within this perspective, drawing on the philosophical work of Heidegger, as knowledge is considered to be neither 'subjective' (particular to the individual) nor 'objective' (independent of the individual) and reality is no longer static, but a continuous changing process (Winograd and Flores, 1987). The distinction between a knowing 'subject' and a separable 'object' is questioned; the knowing subject is no longer considered as separate from the world but as embedded in practice, dialogically forming a fundamental unity of being-in-the-world (*Dasein* in Heidegger's terms) through social interaction within teams, organizations and society (Scheff, 2000). The locus shifts from an individual to a social level as knowledge is considered to reside in the mind while minds are thought to reside in communities of minds, thus the fate of knowledge in a mind is partly shaped by interaction with other minds in the community (Hutchins 1988, cited by Star, 1998). Knowledge is recognized as an abstract and confusing concept that cannot be always codified and transferred easily (Polanyi, 1962). It is classified into types using two dimensions, namely the tacit-explicit and the individual-collective dimension (Nonaka and Takeuchi, 1995) and is validated in light of the perspective the individual assumes it (Bruner, 1990; von Krogh, 1998). Language becomes the most important of symbolic means, is no longer abstract, but ordinary, day-to-day, based on narratives and dialogues (Bruner, 1986; Engeström 2001). Language is considered fundamental in describing, framing and shaping social reality (Burger and Luckmann 1967). Wertsch (1991) emphasizes the role of language in functioning like a conduit that transfers thoughts from one person to another, in promoting particular attitudes and behaviours and discouraging others, in constructing

and constituting social entities and relations. Verbal or written, language conveys meaning and generates new meaning (ibid., 1991).

Having arguably established an idea of how knowledge is conceptualized within the perspective of constructionism, the section draws on critical theories shaped by the principles of constructionism to understand the process of knowledge creation. The theories of Tsoukas (2001) on dialectical thinking and self-formation, Goffman (1959) and Wertsch (1991) on social interaction, Vygotsky (1978) on use of mediational means are integrated on a single framework in order to conceptualize knowledge creation through practice and social interaction shaped and mediated by mediational means such as tools (technical tools) and signs (psychological tools).

Tsoukas (2001) has developed a theory of knowledge creation drawing on Bell (1999) and Mead (1934) to suggest that knowledge is created from the exercise of judgement, from the self-conscious need to re-order, re-arrange, re-design what one knows. His assumptions are based on the dialogical nature of individual thinking and the self-formation of an individual through the eyes of others that he/she interacts with, as he/she decentralizes, keeps a distance and criticizes his/her thoughts, desires, emotions, and acts through internal and external dialogue (cf. Meichenbaum, 1977). Self-consciousness and individual thinking then arise as an individual adopts the group of attitudes and acts towards him/herself as others act towards him/her, having adopted the same group of attitudes, within a social context of experience that he/she and they share (cf. Goffman, 1959). The individual becomes an object to him/herself, a 'generalized other' in order to enter his/her own experience as a self through external initially dialogues with other individuals of the same community and internal later reflective dialogues with the generalized others (Tsoukas, 2001). He/she learns the roles of the others and the relationships between them and then adopts the attitude of the whole community. The individual reflection is then expanded to imagine the roles of other in future unknown situations, find reference entities that reflect back what one already knows (tacit knowledge), exercise his/her judgment through conversation thus creating new ways of using knowledge, inventing new approaches to the world, give new meanings to materials and so on (Scheff, 2000, cited by Tsoukas, 2003).

Social interaction is a nodal point in Tsoukas's theory and generally rules the perspective of constructionism thus is considered essential to understand what social interaction entails and how is connected to context in which it takes place. A valuable

insight can be offered by Goffman's writings (1959) on social interaction in a face-to-face context, which is characterized by the reciprocal influence of individuals upon one another's actions. Goffman explained social interaction using two frameworks, the 'front region' and the 'back region'. In face-to-face interaction 'actors perform', to use Goffman's terms, share the same front region, but have different back regions (see Figure 1).

Back Regions   Front Region   Back Regions

Primary interactive
framework
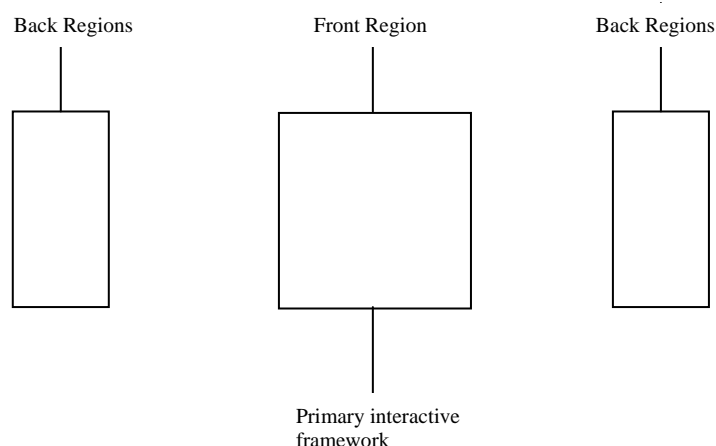
Figure 1: The social organization of face-to-face interaction (adapted from Thompson, 1995)

Taking the individual's performance as the basic point of reference, Goffman interprets the social interaction as a whole considering the full set of participants. Action takes place in a shared front region, a setting that stays put geographically speaking, (e.g. an office, a class), can be directly observed by others and is related to the image the actor evokes in his public by more or less purposefully disclosing his subjectivity. Actions, that seem to be inappropriate or contradictory, for that image, are suppressed and reserved in the back region, where the others can not intrude that easily, for future use, allowing the actor to act in a thoroughly calculating manner, expressing him/herself in a given way, required by his group or social status. It is not always easy to identify the distinction between the front region and the back region of a performance, as there can be regions which function at one time and in one sense as a front region and at another time and in another sense as a back region. For example, when one is in his office with clients or other employees can be considered to act in a front region, whereas the same geographical setting can be thought of as the back region before or after the meeting.

With regards to the others, they require and/or convey information about the actor (i.e. general socio-economic status, competence, trustworthiness, etc.) or they use information about him/her already acquired. The shared front region makes various sources of information accessible to the others that fall into two broad categories of sign activities, the expressions that the actor gives (e.g. through verbal symbols) and the expressions that the actor gives off (e.g. through the appearance, expressiveness). According to Goffman, the expressions that the actor gives can be relatively easy manipulated by the individual in contrast to the expressions that he gives off, over which he/she seems to have little concern or control.

What is missing from Goffman's interpretation of social interaction is the importance of mediational tools (i.e. language, technical tools etc.) in shaping social interaction. While Goffman gives interesting insight to social interaction in a shared context, his theory suffers from not addressing how the actor and the others use the resources that a particular occasion provides (cf. Suchman, 1987).

Wertsch (1991) drawing on Vygotsky (1929-1984) and Bakhtin (1981-1986) suggests that human action should be understood in relation to "mediational means" such as tools (technical tools) and signs (psychological tools), which shape and mediate action in social life. Vygotsky, influenced by Marxist philosophy, viewed tool use as a necessary, though not sufficient, condition for the emergence of knowledge, as Marx and Engels viewed tool use essential for the emergence of labour (ibid., 1991). The main themes that run through Vygotsky's writings are the claim that higher mental functioning in the individual derives from social life and the claim that human action is mediated by tools and signs. Vygotsky's theory (1978) contributes to the conceptualisation of knowledge creation as a process carried out with the help of psychological tools (i.e signs, symbols) as opposed to technical tools such as computers. Most importantly, language (i.e. internal and external dialogues) is considered to function in exactly the same way as other means of activity, explored in the materialist tradition. The difference according to Vygotsky between productive and communicative means is that technical tools have external effects, while language and other systems are directed internally.

Using the constructionist perspective as the theoretical basis for the paper and pulling together the theories of Tsoukas on dialectic thinking and self-formation, Goffman on social interaction in front and back regions and Vygotsky on the use of mediational

tools, the paper argues that the process of knowledge creation needs to be understood as a process of social interaction in a specific context that involves the continuous understanding of oneself and others through which, the 'self' is discursively formed and reformed with the use of mediational means that shape and frame knowledge creation. Considering the above literature on knowledge creation a gap has been identified in the literature, as increased evidence (Kasper-Fuehrer and Ashkanasy, 2001; Lipnack and Stamps, 1997) reveals a new context of collaboration and communication, the virtual context, where knowing in practice is constituted by the ongoing activities of distributed individuals (DeSanctis and Monge, 1999; Orlikowski, 2002). Using the framework presented above, the following section aims to address the underlying social processes that must be taken into account, in order to conceptualise knowledge creation in a virtual context based on the argument that virtuality could differentiate knowledge creation.

3. Virtuality

Virtuality is according to Morse (1998) a socially constructed reality mediated by electronic media (PC, mobile phone, fax etc.). In order to provide a better understanding, the concept of virtuality is juxtaposed with 'physicality', the realm of face-to-face interaction between individuals, in which construction of social reality takes place (cf. Burger and Luckmann, 1966). One of the most important characteristics of virtuality is the dimension of time-space distantiation (Giddens, 1991a). Prior to the development of ICTs the main mode of communication between individuals within an organizational context is face-to-face interaction in a shared place and time. In a virtual context individuals may interact asynchronously and in the cyberspace through the mediation of ICTs, a social phenomenon that has an impact on their communication and consequently on knowledge creation (Thompson, 1995).

Going back to Goffman's conceptual framework, mediated interaction between individuals involves a separation of the contexts within which individuals interact. A framework of various front regions is established, which are separated in space and perhaps in time and still have their respective back regions. Thompson (1995) argues that in mediated communication the distinction between front and back region is less clear in comparison with face-to-face communication and individuals shift boundaries more often between the front and back regions.
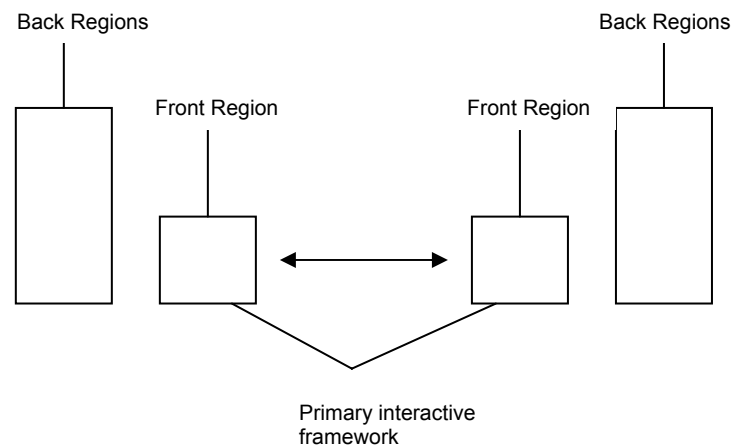
Figure 2: The social organization of mediated interaction by ICTs (adapted from Thompson, 1995).

Separation of contexts may result in loss of the sense of social presence as individuals become disembodied beings that can potentially be anywhere in the universe without the actual embodied presence (Dreyfus, 2001). Reality appears anonymous, opaque and inaccessible, without the sociability, warmth and sensitivity of face-to-face communication (Short et al., 1976; Van Dijk, 1999).

Marx had foreseen that the power of technological innovation would drive social change, influence and become influenced by the social structure of society and human behaviour (Wallace, 1999). ICTs offer information for nearly every type of social action and the ability to live online in different types of social communities, which appear to be:

- more diffused as they stretch further and further across time and space;
- less hierarchical due to the greater demands of changing knowledge requirements and greater equality in participation;
- less stable and concrete without time, place, physical ties;
- more abstract with the increasing use of symbolic means;
- shaped upon special interests;
- offering new modes of exercising power as the use of networks can both disperse and concentrate power

Gidden's (1991a) suggests that a more reflective society is being formed due to the massive information received, while Van Dijk (1999) describes an increasingly passive society, where more is read than written, more is listened than spoken. Symbols

received and transmitted in mediated interaction, can be preserved (i.e. textual electronic files), allowing potential members to observe the norms of the community they enter, as well as existing participants to keep track of the history of the community.

Language is also affected by mediated interaction as only a narrowed range of nonverbal symbolic cues can be transmitted to distant others to express oneself and interpret the expressions of others (Foster and Meech, 1995; Wallace, 1999; Sapsed et al., 2002). Social cues associated with face-to-face co-presence are deprived, while other symbolic cues (i.e. those linked to writing) are accentuated (Thompson, 1995). Therefore, the additional meaning found in direct auditory and visual communication, carried by inflections in the voice tone, gestures, dress, posture, as well as the reflexive monitoring of others' responses, is missing. Furthermore, human senses such as touch, smell, taste cannot be stimulated (Christou and Parker, 1995). These symbolic cues convey information regarding the meaning individuals assign to the language they use as well as the image they want to project while expressing themselves. Consequently, language remains open to multiple interpretations, as individuals have greater difficulty to negotiate variation in language and need more time and information to feel confident that they have reached a mutual understanding of themselves and others (Sproull and Kiesler, 1991, cited by Ridings et al., 2002).

To summarize the specific characteristics of virtuality, mediated interaction by ICTs, loss of sense of social presence in a shared context, change in structure of society, different front and back regions, elimination of social cues being transmitted, are some of the issues that typify virtuality as opposed to physicality. Having established arguably an understanding of virtuality, the following section attempts to pull together the literature on knowledge creation and the literature on virtuality in order to conceptualise knowledge creation in a virtual context.

4. Knowledge Creation in a Virtual Context

The presentation of the two bodies of literature has arguably established an understanding of knowledge creation and virtuality. Pulling together the theory of knowledge creation that claims that the discursive formation of 'self' with the use of mediational means is a source of knowledge creation that needs to be understood in relation to self-understanding and understanding of others, as well as the specific characteristics of virtuality, the research question that raises is "*How is knowledge*

created in a virtual context?". The paper argues in this section that the process of knowledge creation could take different characteristics in a virtual context that theories of knowledge creation should recognise.

The discussion should start from the basic argument that knowledge creation even in a virtual context needs to be understood from the perspective of social interaction. Social interaction in a virtual context as part of knowledge creation is mediated by ICTs as shown in the previous section. Language becomes even more important as ideas in the form of symbolically coded information such as written language become textualized, transmitted by media free of context, and when received become recontextualized; rearranged, re-ordered and differentiated based on already acquired knowledge. Self-understanding and understanding of others, described in theories of knowledge creation in a face-to-face context, is affected by the type and amount of abstract mediational symbols that can be used as tools to internalise unfamiliar knowledge (Hutchins, 1995). Considering Tsoukas's (2001) claims on self-formation through the eyes of others, it could be argued that in a virtual context self is formed, as part of knowledge creation, through a narrowed range of nonverbal symbolic cues that can be transmitted. While Morse (1998) suggests that self-understanding and understanding of others depends on the imagination of one as he/she becomes able to construct personas in the language used while taking advantage of the lack of other visual cues, the importance of language is recognized in a virtual environment despite the greater ambiguity created regarding its meaning. The argument could be better understood in a specific organizational context, the context of virtual teams, which is presented in the following section,.

5. Definition and Specific Characteristics of Virtual Teams

The development of ICTs has dramatically altered the structure of organizations, which increasingly begin to rely on 'virtual teams', which are defined as groups of geographically dispersed individuals, who are assembled via ICTs to accomplish an organizational task (Jarvenpaa and Leidner, 1999). Individuals are linked together, using a variety of mediated communication technologies, including traditional ones, like paper, phones, fax machines, bulletin boards and email, and more advanced technologies, such as synchronous chat systems, videoconferencing, collaborative software, intranets, and private networks. The development and increasing importance of virtual teams comes from their numerous benefits for organizations, namely

improved productivity, flexibility, lower costs, improved resource utilization, increased speed and agility, limits of time, space, and culture being transcended, teams' rapid reorganization and dissolution within the needs of a global marketplace (Lipnack and Stamps, 1997; Mowshowitz 1997; cited by Jarvenpaa and Leidner, 1999; Duarte and Snyder, 1999; Majchrzak et al., 2000; Glassop, 2002; Overholt, 2002).

Lipnack and Stamps (1997) suggest that virtual teams include:
- *people* that are members of such teams.
- the *purpose*, which constitutes the raison d'etre for the team.
- *links* such as channels, interactions, and relationships through which people communicate.

Different types of virtual teams can be identified based on the typology offered by Panteli and Dibben (2000) who suggest three dimensions of virtual teams:
- level of permanency or continuity of the team,
- degree of geographical dispersion of the team
- and its relation to the firm.

The first dimension refers to the level of permanency, as a team may be permanent or temporary (ibid., 2000). The second dimension of virtual teams is the degree of geographical dispersion, which varies among virtual teams. Most often virtual teams are at least partially co-located. The third dimension refers to the relation of the virtual worker to the organization, as virtual team members can be attached to a particular organization or employed on a short or long term contract with the firm.

Comparing virtual teams to face-to-face teams would enable a deeper understanding of virtual teams. According to Duarte and Snyder (1999), what virtual and face-to-face teams have in common is that team members communicate and collaborate to get work done. The difference is that virtual teams, unlike face-to-face ones, may accomplish this task, by working across distance, time and organizational boundaries. Considering the above argument and relying on Thompson's (1995) theory on virtuality, it could be argued that the significant characteristic that differentiates virtual teams from any other teams is the central role of mediated interaction by ICTs, as the primary means of communicating and collaborating, which replaces traditional face-to-face interaction. Virtual teams are more likely than face-to-face teams to consist of members with more heterogeneous social characteristics, due to lack of traditional spatial and

team constraints, such as lifecycle stage, gender, ethnicity, and socio-economic status (Hiltz and Wellman, 1997). However, individuals that form virtual teams often share the same interests, which results in more homogeneous attitudes and cohesive teams (ibid., 1997).

Team members are required to work interdependently with one another and share knowledge about task-related processes in order to maximize performance. To achieve that an understanding of each other's preferences, strengths, weaknesses, and tendencies is needed to co-ordinate, adjust their actions effectively, reach compatible decisions, and then put them to practice (Salas et al., 2000; Cannon-Bowers and Salas, 2001). Metiu and Kogut's (2001) studies on dispersed settings support that successful problem solving in virtual teams demands a common understanding of the work, as well as a strong sense of the identities of the people involved in the project. Considering the virtual context, this understanding has to be achieved, taking into account lack of common working history, lack of common references to draw upon, sharing different front regions, difficulty to interpret cues in a similar manner and difficulty to build trust (Cannon-Bowers and Salas, 2001).

6. Summary and Conclusions

Having discussed theoretically knowledge creation in a virtual context, and specifically in the organizational context of virtual teams the paper has argued that the specific characteristics of virtuality differentiate knowledge creation.

Considering the process of knowledge creation in a virtual context it has been emphasized that the process is shaped by social interaction in a specific context and permeated by the discursive formation of self as participants try to make sense of each other and themselves. Actions are shaped and framed by 'mediational means', whose use is a necessary, though not sufficient, condition for the emergence of knowledge. The papers has drawn on the theories of Tsoukas on dialectic thinking and self-formation, Goffman on social interaction in front and back regions and Vygotsky on the use of mediational tools to argue that the process of knowledge creation needs to be understood as a process of social interaction in a specific context that involves the continuous understanding of oneself and others through which, the 'self' is discursively formed and reformed with the use of mediational means.

The importance of social interaction and language in a face-to-face context had been emphasised so far, leaving a gap in the literature as development of ICTs revealed a new context of social interaction, the virtual context. The paper presented the specific characteristics of virtuality and emphasized how they could differentiate knowledge creation. Namely, mediated interaction by ICTs, loss of sense of social presence in a shared context, change in structure of society, different front and back regions, elimination of social cues being transmitted, are some of the issues that typify virtuality as opposed to physicality and could differentiate knowledge creation.

The significance of the paper is based on the emphasis given to the factors that might be considered in order to develop a full theory of knowledge creation in a virtual context that could also provide useful insights to a face-to-face context. Further research could focus on revisiting and updating current theories of knowledge creation.

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