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Situated Cognition, Vygotskian Thought and Learning from the Communities of Practice Perspective: Implications for the Design of Web-Based E-Learning

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Abstracts

This paper describes the key notions of situated cognition, Vygotskian thought (zone of proximal development, the general law of cultural development and the mediational nature of signs and tools), and learning from the community of practice perspective. From these notions, we conceptualize principles on learning through which design considerations relevant to the web-based e-learning environments are drawn. These community-oriented web-based design principles can be summarized under four dimensions: situatedness, commonality, interdependency, and infrastructure. These e-learning design principles are illustrated with current web-based examples. In particular, the infrastructure dimension is of particular significance to web-based online environments. Rules and processes relevant to face-to-face communities may have to be radically transformed in the context of web-based e-learning communities.

Situation de connaissance, pensée de Vygotsky et apprentissage des communications en perspective pratique : Implications par l'élaboration de l'apprentissage basé sur le Web.

Dans cet article nous décrivons les notions d'une situation de connaissance Vygotskian pensait (zone de développement proches, les lois générales de développement culturel et la nature médiationnelle des signes et des outils) que l'apprentissage à partir de la communauté était en pratique perspective. A partir de ces notions nous avons extrait les principes de construction relevant de l'environnement éducatif basés sur le web. Ces principes sont recommandés dans le contexte de réunir le fossé entre l'école et le lieu de travail. Nous illustrons ces principes avec un exemple utilisant le « Knowledge Forum » y compris les recommandations suggérés sur la façon dont la construction de la connaissance (knowledge) peut être poussée plus loin de façon à inclure les principes identifiés de la conception du e-learning.

Kontextbezogene Wahrnehmung, Vygotskys Ansatz und Lernen durch Umgang mit Gemeinschaften: Folgerungen für die Gestaltung von web-basiertem E-Lernen

In diesem Beitrag beschreiben wir die Schlüsselbegriffe von kontextbezogener Wahrnehmung ("situated cognition"), Vygotskys Überlegungen (Zone der nächsten Entwicklung, das allgemeine Gesetz der Kulturentwicklung und die Vermittlungseigenschaften von Zeichen und Werkzeugen) sowie das Lernen von der Gemeinschaft aus dem Praktizieren heraus. Auf Grundlage dieser Gedanken entwickeln wir Regeln für den Entwurf von web-basierten E-Lernumgebungen, deren Anwendung zur Überwindung des Unterschieds zwischen schulischem und beruflichem Lernen empfohlen wird. Wir belegen diese von uns entwickelten Grundsätze durch ein Beispiel, in dem wir "Knowledge Forum™" einsetzen und Vorschläge zur weiteren Entwicklung der Wissensvermittlung unter Nutzung der beschriebenen Designregeln machen.

Introduction

In today's context, it is relatively easy to set up discussion forums with web management tools (such as *Blackboard – CourseInfo*). However, just creating these environments does not ensure that these facilities are well used by participants. Why is it that many web-sites have chatrooms, discussion boards, bulletin boards and other similar forums when they just do not work, in that they do not foster a rich and sustained dialogue among participants? This paper attempts to understand the recent notions of situated cognition and the related notions of Vygotskian thought and communities of practices in order to understand what makes a community vibrant and sustaining. People, forming a community, come together because they are able to identify with something – a need, a common shared goal and identity.

Brown and Duguid (2000) neatly synthesized learning as demand driven, a social act, and as identity formation. These three categorizations of learning sum up the recent perspective of ‘community of practice’ as learning environments. Brown and Duguid (2000) state: ‘Practice is an effective teacher and community of practice an ideal learning environment’ (p. 127). Learning from a ‘community of practice’ perspective is also congruent with the recent notions of situated cognition (Brown *et al.*, 1989), where context – the social practice and activity structures undergirding the practice – are fundamentally inter-woven with cognition and learning. The notion of learning as ‘demand driven’ is similar to the popular coinage of ‘just in time’ learning. A demand perspective suggests the need not to over emphasize the force-feeding type of learning where learners cannot make sense of applications for such knowledge fed to them. From a practice perspective, problems are faced in the context of the situation at the workplace and a demand is created for the learner to solve the problem through which his/her performance is based on successful solutions.

From the perspective of learning as a social act, recent literature on situated cognition emphasize the importance of how people socially construct meanings and appropriate social cultural norms. Learners through legitimate peripheral participation (Lave and Wenger, 1996) ‘steal’ implicit and explicit knowledge through participating and observing practitioners at the periphery or side (Brown and Duguid, 1996). Though the process is similar to apprenticeship, learners gradually acquire skills of the trait, norms and rules held by the community of practice. Soon, they move from peripheral participation to central participation (Hung, 1999).

One of the key notions of situated learning is that of appropriating from the practice ‘ways of seeing’ (Hung, 1999). In other words, these learners acquire a ‘lense’ for seeing meanings that are identified with the community of practice. An identity, for example, of doctors, engineers, lawyers, etc., is evident through the genres (speech acts) used by the practitioners in the profession. Identity formation takes place through the appropriation of the beliefs, values and skills required in a practice – seen through the ‘lense’ of a particular practice.

The above notions that describe learning are not radically new. Vygotskian writing and similar veins of thought relating to situated cognition and communities of practice, in essence, provide grounding to the above views. The purpose of this paper is to describe these theoretical groundings and draw implications to the design of web-based e-learning environments.

Situated cognition

In the context of the above, situated cognition implies that the activities of person and environment are parts of a mutually constructed whole. Viewed actively, the adaptation of person and environment involves mutual modification rather than static matching (Maturana and Varela, 1987). Such an interactivist (Bickhard, 1992), relational (Lave and Wenger, 1991), dialectical (Clancey, 1991) or transactional (Dewey and Bentley, 1949) view focuses on *processes* in interactivity. Meanings are perceived as inseparable from interpretation, and knowledge is linked to the relations of which it is a product (Dewey, 1910/1981). In other words, knowledge is not just a mental state; rather, it is an experienced relation of things, and it has no meaning outside of such relations (Dewey, 1910/1981, p. 185). Hence, mind is perceived as an aspect of person–environment interaction, where activity involves a transaction between person and environment that changes both (Dewey and Bentley, 1949). Bateson viewed such a process as a series of interactional cycles (Bateson, 1972, 1979). In which case, learning should occur in rich situational and activity-practice contexts allowing for interactional and dialectical ‘struggles’ in cognition whether with other individuals, artifacts, ideas, tools, and problems (Hung, in press; Hung and Wong, 2000).

Similarly, according to Vygotsky (1978, 1981, 1997), studies should consider what the environment means for the child and the child’s relationship to the various aspects of the environment – hence, the dialectical relationship. Vygotsky meant here not a passive relationship or perceiving or processing incoming stimuli, but a relationship defined by the child’s needs and goals – a relationship defined by the forms of social practice that ‘relate’ the child to the objective environment and define what that environment means for the child. Therefore, if we adopt the central underpinnings of situated cognition, it is the *history* of a relationship that causes an outcome, not the actions of one or another party alone. Constraints that are relevant for interpreting and guiding the process are also reconceived in relational (rather than internal or external) terms, as signified by such concepts as situation or context. In other words, the situated perspective points toward defining things that emerge from within the process of acting and inquiring (Bredo, 1994). Such a historical focus in situated cognition is congruent to Vygotskian thought. Vygotsky’s historical method of development stresses that we need to concentrate not only on the *product* of development but on the very *process* by which higher forms are established – fundamentally, to discover its nature and its essence.

Before we delve into a more detailed account of Vygotskian thought, the above synthesis would imply that the dynamic social environment, for example, the meaningful learning context has a profound impact on the learner – in particular the appropriation of contextual and implicit (process) knowledge (Hung, 1999; Polanyi, 1964). A central Vygotskian thought is that even when mental functioning is carried out by an individual acting in isolation, it is inherently social, or sociocultural, in that it incorporates socially evolved and socially organized tools (Bruner, 1996; Wertsch, 1998).

The current forms of school-based learning, where knowledge is being abstracted out of the (scientific) context to the classroom has undermined the situated meanings that can be picked up tacitly. As a preliminary, the notions of learning from the communities of practice perspective brings back this emphasis of embedded learning in the workplace, of which, we argue that e-learning on the web may be a possible platform for situated or contextual learning. Web-based e-learning is fundamentally not constrained by specific locations and classrooms but can be infused into varying learning situations.

Vygotsky and communities of practice

Vygotsky identified two tasks as basic to the analysis of the child's psychological development: the analysis of the social situation that defines the child's life (the intermental level); and the analysis of the psychological structures that develop in connection with this mode of life (the intramental level). Vygotsky applied this general conceptual framework to a broad range of issues. These dimensions are underpinned by three propositions concerning the genetic law of cultural development, the zone of proximal development (ZPD), and the role of sign and tool mediation.

Foundational to Vygotskian thought is this notion of the 'general genetic law of cultural development' – the thesis of the social formation of the mind. It theorizes the social in connection with the psychological.

Any function in the child's cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological category, and then within the child as an intrapsychological category. This is equally true with regard to voluntary attention, logical memory, and formation of concepts, and the development of volition. We may consider this position as a law in the sense of the word, but it goes without saying that internalization transforms the process itself and changes its structure and functions, Social relations or relations among people genetically underlie all higher functions and their relationships.

(Vygotsky, 1981a, p. 163)

It is in the context of the social formation of the mind that the concepts of the zone of proximal development and the mediation of tools are grounded. The above law as described can be actualized in instructional settings such as the ZPD, where the social and the individual are brought together. It is in the ZPD that the so-called 'psychological tools' (particularly speech) and signs have a mediational function.

First, the concept of the zone of proximal development (ZPD). Vygotsky defined the ZPD as the distance between the child's 'actual development level as determined by independent problem solving' and the higher level of 'potential development as determined through problem solving' under adult guidance or in collaboration with more capable peers (Vygotsky, 1978, p. 86). The concept of the ZPD generally exemplifies Vygotsky's concern with the role of assistance or instruction and also of assessment. His interest would be in assessing how learners make progress. The focus would be on the historical *process* as well as the *product* in assessment. Importantly, Vygotsky is advocating learning and instruction as guided on the context of varying degrees of expertise within stipulated zones of proximal development. In other words, learning could involve interactions between novices (learners) and mature practitioners (more capable and knowledgeable individuals) within the communities of practice (ZPD) framework (Hung, 1999). Fundamentally, adopting the vein of ideas resulting from ZPD, the personal activity and, thus, heterogeneity of the learner must be placed at the base of the educative process, and all the teacher's art must come down to directing and regulating this activity (Davydov, 1995; Vygotsky, 1926/1997). In essence, recognizing individual current levels of cognition and tailoring a personalized instruction for the learner within the stipulated ZPD would be the ideal learning situation. The recent notion of cognitive apprenticeship (Brown *et al.*, 1989) is one such 'instructional approach' used within stipulated Zones of Proximal Development.

Second, Vygotsky argued that the higher mental functions rely on the mediation of behaviour by signs and sign systems, the most important of which is speech. Vygotsky saw signs as a special type of stimuli that are used as 'psychological tools', tools that are 'directed towards the mastery of control of behavioral processes — either someone else's or one's own — just as technical means are directed towards the control of nature' (Vygotsky,

1981b, p. 137). With its inclusion in behaviour, ‘the psychological tools alters the entire flow and structure of the mental functions . . . by determining the structure of the new instrumental act, just as a technical tool alters the process of natural adaptation by determining the form of labor operations’ (Vygotsky, 1981b, p. 137).

The following can serve as examples of psychological tools and their complex systems: language; various systems of counting; mnemonic techniques; algebraic systems; works of art; writing; schemes, diagrams, maps, and mechanical drawings; all sorts of conventional signs; and so on.

(Vygotsky, 1981b, p. 137)

The specific function of a psychological tool is that it permits the humans, by the aid of extrinsic stimuli, to control their behaviour from the outside (Vygotsky, 1978). Vygotsky draws the example of tying a knot with a handkerchief around one’s figure to serve as an external extrinsic stimulus for reminding the individual of an action to be achieved. Vygotsky saw these rudimentary sign-means as evidence of the historical transition from natural to mediated forms of behaviour, forms of behaviour in which man himself determines his behavior with the help of an artificially created stimulus means (Wertsch and Tulviste, 1996).

In essence, Vygotsky argued that ‘a sign is always originally a means used for social purposes, a means of influencing others, and only later becomes a means of influencing oneself’ (Vygotsky, 1981a, p. 157). And focusing more specifically on the sign system of language, he argued that the primary function of speech, both for the adult and for the child, is the function of communication, social contact, influencing surrounding individuals (Vygotsky, 1978). In other words, through social interaction and communication through mediated tools, there is a form of metacognitive self-regulation of behavior through reflection in action. Through such a process, internalization and learning occurs.

Synthesizing situated cognition and Vygotskian thought, we recognize that the way mediational tools are used can vary based on the activity cum practice context. Mediated tools are meaningful only in the context of its situation and use. Mediated action is always constrained in fundamental ways by the fact that existing cultural tools are used. Hence, if cognitive development proceeds through the construction of meaning from meaningful activities, an understanding of the cultural structuring of activity is crucial to an understanding of the ways in which meanings evolve differently in different contexts. Meanings, tools and goals all necessarily relate the individual and the social world of which the individual is part, for they are all formed in socio-cultural context. The use of tools in any cultural practice is jointly constructed by the individual and by the culture in which the person or learner is developing, with the assistance of those who are already more competent (within the ZPD) in the use of those tools and in culturally appropriate goals (Hung, 1999).

In the same vein, a four-fold conception of development was proposed in post-Vygotskian research (Minick *et al.*, 1993):

- (1) The culturally specific nature of practice, for example schooling, demands close attention to the way in which any particular practice structures interactions between people and artefacts.
- (2) Rather than language being understood as a generalized or abstract system that mediates activity interaction, and thought, it should be treated as a multitude of distinct speech genres and semiotic devices that are tightly linked with particular social institutions and practices.
- (3) Educationally significant human interactions do not involve abstract bearers of cognitive structures but real people who develop a variety of interpersonal relationships with one another in the course of their shared activity in a given institutional context.
- (4) Modes of thinking evolve as integral systems of motives, goals, values and beliefs that are closely tied to concrete forms of social practice.

For example, if the ‘social’ in teaching and learning is constrained to a view of particular teaching technologies and procedures then the analysis of schooling is both truncated and partial. If the ‘social’ in schooling is considered in socio-institutional terms then the gaze of the analysis of the outcomes is altered and/or extended.

Congruent to the situated cognition view, contexts could include practices, both implicit and explicit social relationships to an activity, of which, these notions are indexical to cognition. Institutions and communities are fundamentally identifiable by their activities, practices and tools used. Communities of practices are also connected by socially constructed webs of beliefs and ways of thinking. What we consider real and authentic within a community of practice is framed by its culture and demands. Their meanings are socially constructed through negotiations among present and past members of varying expertise. Activities thus cohere in a way that is, in theory, if not always in practice, accessible to members who move within the social network. Thus, the historical evolution of a practice creates the implicit knowledge which is often overlooked (Brown and Duguid, 2000). In

other words, within an activity context, cognition, and this learning, is socially distributed between persons, tools and rules of the practice (situational context).

Context and utterances are also linked in activity by speech genres (Bakhtin, 1986). However, the social situation cannot be described just in terms of the structure and/or content of genres. Voloshinov (1983) argues that ‘the forms of signs are conditioned above all by the social organisation of the participants involved and also by the immediate conditions of their interaction’ (Voloshinov, 1983, p. 21).

Talking physics and writing criticism are *social practices*. They are parts of larger social activities. They are learned socially, function socially, and are socially meaningful. Spoken and written language are social resources for making social meaning. And the specific *genres* and *semantic patterns* of physics, or of literary criticism, are institutionalized social formation, patterns of language *use*, and patterns of *deployment* of the social resources of language in particular communities and subcommittees.

(Lemke, 1988, p. 82)

The finding that children use particular written genres because of the context in which they are learning means that even when teachers are not conscious of what they are doing, they have a powerful effect, not only on the children’s writing development, but on the kind of knowledge being constructed in the classroom (Foley, 1991). In other words, learners draw a lot of implicit knowledge, including genres, through participation within an activity situational context, for example students pick up naïve theories of learning without being told what learning is all about.

Implications for web-based e-learning environments

From the above synthesis of situated cognition, Vygotskian thought and communities of practice, the principles of learning are categorized into four dimensions – *situatedness*, *commonality*, *interdependency*, and *infrastructure*. These four factors contribute to a vibrant and sustaining community:

(1) *Situatedness* – one of the strongest arguments of situated cognition is that of ‘situatedness’ in rich contexts of practice. When learning is embedded in rich situations and social constructive acts where meanings can be made sense in the contexts of application and use, learners pick up both implicit and explicit knowledge (Brown and Duguid, 1996). The demands or goals for understanding are clear to the learner because the tasks involved are meaningful and that learners would probably be able to situate the tasks or sub-tasks in the context of the larger and more global ‘picture’. Moreover, because learning is embedded in rich situations, learners would be also able to reflect on their actions and discuss issues and problems with fellow members of the community.

(2) *Commonality* – it is important to have a valid reason for participants to work together in a way that makes sense to them – such as shared interests and problems that requires joint effort (Lave and Wenger, 1991). Through the process of working together in common areas and interests, the participants develop a similar bonding or identity with one another. Commonality also includes a common set of genres, signs, tools and speech acts understood by members in the community.

(3) *Interdependency* – interdependency in practice exists when the structure in a community leverages on different demands of the participants in the community. In other words, participants can interact based on varying needs, expertise (knowledge and skills), perspectives and opinions. Hence an important necessity in web-based e-learning communities is that there exists varying demands and expertise of different competency levels where participants can “make use” of each other’s abilities and narrowing the weaknesses (Wenger, 1998). Participants develop the areas in which they are most interested and capable, with the responsibility that they share their expertise with the other participants. By utilizing diverse expertise, the e-learning community can deal with problems and issues that are too difficult for any one individual to handle. An individual learns not just from the activities that they carry out themselves but from different members of the community.

(4) *Infrastructure* – in sustaining and vibrant communities, there is a need for a supporting infrastructure where participants are clear as to the processes in engaging in any activity. Such a structure enables participants to be structurally-dependent on each other (Bielaczyc and Collins, 1999). There are specific rules and mechanisms for accountability in order to facilitate the work processes involved. This dimension is of particular significance to web-based environments, and we will expand on this in the later section. Table 1 below summarizes the main principles describing the processes of learning as denoted by situated cognition and Vygotskian thought.

We use two community-oriented web-based e-learning environments to illustrate the learning principles above. One example of a web-based e-learning community that capitalizes on the dimensions as described above is

Table 1 *Design considerations based on situated, commonality and interdependency*

Principles of situated cognition and Vygotskian thought	Design considerations for e-learning
<p>Situatedness</p> <ul style="list-style-type: none"> • Learning is embedded in rich cultural and social contexts – acquiring both implicit and explicit knowledge. • Learning is reflective and metacognitive, internalizing from social to the individual. 	<ul style="list-style-type: none"> • E-learning environments should be Internet or web based so that with such a common networked platform, learners can access the learning environment in their embedded and situated contexts – anywhere and anytime. • E-learning environments should be portable as far as possible so that they can be used in the context. • E-learning environments can focus on tasks and projects, thus enabling learning through doing and reflection-in-action. • E-learning environments can focus on depth over breadth, thus enabling learners to analyse communicative ‘speech acts’.
<p>Commonality</p> <ul style="list-style-type: none"> • Learning is an identity formation or act of membership. • Learning is a social act/construction mediated between social beings through language, signs, genres and tools. 	<ul style="list-style-type: none"> • E-learning environments should create a situation where there is continual interest and interaction through the tools (e.g. mind-tools) embedded in the environment. • E-learning environments should capitalize the social communicative and collaborative dimensions allowing mediated discourse. • E-learning environments should have scaffolding structures which contain the genres and common expressions used by the community.
<p>Interdependency</p> <ul style="list-style-type: none"> • Learning is socially distributed between persons and tools. • Learning is demand driven – dependent on engagement in practice. 	<ul style="list-style-type: none"> • E-learning environments should create interdependencies between individuals where novices need more capable peers capitalizing on the zone of proximal development. • E-learning environments should be designed to capitalize on the diverse expertise in the community. • E-learning environments should be made personalized to the learner with tasks and projects as embedded in the meaningful activity context. • E-learning environments can track the learner’s history, profile, and progress and tailor personalized strategies and content.
<p>Infrastructure</p> <ul style="list-style-type: none"> • Learning is facilitated by an activity – driven by appropriate mechanisms and accountability structures. 	<ul style="list-style-type: none"> • E-learning environments should have structures and mechanisms set up to facilitate the activity (project) processes where learners’ are engaged in. • E-learning environments have the potential to radically alter traditional rules and processes that were constrained by locality and time.

www.experts-exchange.com – affiliating those with questions to those who have the answers on IT programming. IT programmers can access such a website when they encounter programming difficulties and problems in the workplace. In other words, the ‘situatedness’ dimension is possible through ‘anywhere and anytime’ access because of the web. There is no need for learners to come out of their workplace context to attend programming courses in order to be equipped with certain competencies. Moreover, because the content of such a site relates directly to learners’ work demands, a great deal of sense-making and reflection resulting in metacognitive actions are undertaken. In other words, there is a situated and embedded reflection-in-action. With current Internet technologies available, personalized content and activities can be delivered to the learner by tracking the history of actions and interactions engaged by the learner.

In www.experts-exchange.com, there is a rating system given to contributors, which can place in very good standing as experts in a particular domain. Contributors may be involved in these sites for varying motives such as the desire to gain reputation. Because of the level of quality discussions and solutions in the community, an affiliation towards the community is grown over time as a person gains credibility in the community. Generally a participant begins his/her ‘journey’ in these communities as a participant and subsequently as an active and known contributor, and may even attain the level of an expert. Such a process is congruent to the learning process within stipulated zones of proximal development. Experts become recognized not just within that particular community, but also by other related online communities. An identity is formed when he or she progresses from a peripheral participant into becoming a central participant of that community. In other words, ‘commonality’ is achieved through an identity formation where participants share common goals and interests. These common goals are mediated by a set of shared programming genres and tools, for example in XML or Java scripts. ‘Interdependency’ is also achieved in www.experts-exchange.com because of mutual and complementary benefits and motives – for example, some who want answers and some who want reputation. There is a clear division of labour between those who seek for answers and those who provide the answers.

In another website www.epinions.com, participants provide recommendations or opinions of a varied nature, e.g. books, appliances, issues, etc. People’s needs of wanting to know about certain things can be found in such a site. The ‘interdependency’ factor is exhibited by ‘expert-opinionators’ giving feedback on products to those non-experts who need the information, perhaps with the intention to purchase that particular product. Participants develop the areas in which they are most interested and capable, with the responsibility that they share their expertise with the other participants. By utilizing diverse expertise, the online community can deal with problems and issues that are too difficult for one individual to handle. An individual learns not just from the activities that they carry out themselves but from different members of the community. A reason why a person would want to make a recommendation, for example in www.epinions.com is because a recommendation is rated by others and one’s effort for giving good recommendations is rewarded. Both the person and the recommendation are recognized internationally. In such a community, there are at least two types of people: those who want to know recommendations and those who seek for recognition in giving good opinions and reviews. In this sense, the mutual benefits and motives of participants constitute the interdependencies and foster the vibrancy of the community.

The ‘infrastructure’ dimension plays an important role among the four factors in establishing a vibrant and sustaining online community. It is also the factor which differs most from the face-to-face community. Apparently, new ways of re-thinking seem to be necessary – we do not need to put ‘old wine’ (face-to-face practices) in new wine bottles (online communities). The infrastructure factor can be further characterized by three tenets – rules and processes, accountability mechanisms and facilitating structures. This is a factor which perhaps could be capitalized for environments on the web.

For the first tenet of infrastructure, any particular community is organized by its rules and processes for engaging in tasks and projects. The rules and processes for www.experts-exchange.com are straightforward being facilitated by a system of points. When users first register with the web site, they are given some ‘settling-in’ points. Users can use these points to pay those who answer their question correctly. Even though a question can get many answers, points are given only to one accepted answer. Normally, one gives between 50–60 points for easy questions and between 100–300 points for difficult questions. The issue here is that experienced experts would not answer a question if it did not carry enough points. Thus for users to have more questions answered, they would have to have more points, and to get more points they would have to answer some questions themselves. The important point to note is that these rules can apply to anyone in the world who can be connected through the web via www.experts-exchange.com.

Thus rules include the different functions and roles of individuals and how they collaborate together as a whole. An example of a rule in face-to-face communities is an *annual* general meeting where members come together

and vote on issues. Using the same example, in an online community, voting becomes easy and is no longer constrained by it being an annual event because the technology can facilitate voting in a more timely fashion. The advantage is that the consequence of the online voting would better reflect or represent the *whole* community. Therefore in web-based communities, the rules, which apply to traditional communities, should not be necessarily carried forward. Important decisions can now be made differently, perhaps in a more efficiently and representative manner. In the same vein, rules and processes that were important in traditional learning situations may have to undergo transformations in the context of e-learning.

The second tenet of infrastructure is its accountability mechanism. In www.epinions.com, accountability emerges through the ratings others give to an opinion provided. In a face-to-face community, an example of accountability could be an executive committee, which is responsible and accountable for the execution of daily operations of a community. In a face-to-face community it is logistically impossible to involve everybody as an executive committee member. The accountability of the performance of the executive committee is reflected through the annual or bi-annual election of executive committee members. In contrast, an online community may not need the functions of an executive committee because practically every member can be a committee member. This is possible because technology can overcome the limitations of accessibility through which more members have access to archived documents and resources. Hence, this creates a more robust accountability mechanism in that accountability of any task is constantly monitored by every member.

The third tenet of infrastructure within communities is facilitating structures that actualize its daily operations. An illustration of facilitating structure in face-to-face communities is physical space (e.g. a conference room) where members gather and a central location (e.g. an office with administrators and secretaries) which individuals identify with. The equivalent of an online facilitating structure is a web site (analogous to the physical space) and the underlying information architecture of the online community (analogous to the physical office where community related 'transactions' are processed). Due to the possible increase of participants and hence the intensity of interactions, the task of managing these 'transactions' becomes possible, feasible and practical only with technology.

We believe that this dimension of 'infrastructure' has been relatively unexploited in web-based e-learning environments. Potentials for radical transformations in rules and processes, accountability mechanisms and facilitating structures for web-based e-learning may be needed.

To reiterate, we have identified that in order to foster a vibrant web-based e-learning community, there are four dimensions:

- (1) *Situatedness* fostered by: contextualized activities, e.g. tasks and projects based on demand and needs; and implicit and explicit knowledge, e.g. ways of seeing such as beliefs and norms.
- (2) *Commonality* fostered by: shared interests, e.g. in books; and shared problems, e.g. in solving programming problems.
- (3) *Interdependency* fostered by: varying expertise e.g. differences in knowledge and skills; varying perspectives or opinions, e.g. differences in views on current issues; varying needs, e.g. those who want to gain a reputation and those who want answers; mutual benefits, e.g. to complete a task that is not manageable by any one individual; and complementary motives, e.g. novices get answers from the experts and experts gain reputation from the novices.
- (4) *Infrastructure* fostered by: rules, e.g. ratings or points system to motivate participation; accountability mechanisms, e.g. credibility of a contributor's review which is appraised by other members; and facilitating structures, e.g. information architecture facilitating the interdependencies.

Conclusion

A significant difference, which would qualify a vibrant and sustaining e-learning community, is an online system which would be able to manage and facilitate the intense interactions and dynamism of both information (content and resources) flow and participants' involvement. This explains why mere chatrooms and discussion forums are too primitive to manage such complexity. The systems, which are described above involves not only the hardware and software but also the rules of the online community involved.

Knowledge lies less in databases than in people. The Internet is good at connecting people, not just presenting information. The more creative we can get in connecting people through the Internet, the larger the pool of diverse expertise we can rally would be. Learning is about dialoging in matters that we need to understand or that trouble us; not just dialoging with anyone, but with those that can challenge us, those who can provide us with a difference. Good and vibrant communities are learning organizations – organized with a structural dependency

on one another. Today, the Internet makes huge communities worldwide. But, unless these online communities are structured appropriately with the four factors, we would just end up with empty communities. Not only would learning principles that work for face-to-face communities apply to e-learning communities, we now have to consider how infrastructures are to be radically transformed in online communities. From the Vygotskian perspective, such infrastructure considerations are the social cultural dimensions of cognition.

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