Design Principles for Web-Based Learning: Implications from Vygotskian Thought

David Hung
Contributing Editor

Introduction

In a recent book, *The Social Life of Information*, the authors John Seely Brown and Paul Duguid (2000) neatly synthesized learning as *demand driven*, a *social act*, and as *identity information*. These three categorizations of learning sum up the recent perspective of the "community of practice" as learning environments. Brown and Duguid 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, Collins, & Duguid, 1989), in which context—the social practice and activity structures undergirding the practice—are fundamentally interwoven with cognition and learning. More fundamentally, there is much congruency between situated cognition, communities of practices, and Vygotskian thought (Vygotsky, 1978, 1981a, 1981b, 1997).

The notion of learning as ‘demand driven’ is similar to the popular concept of ‘just in time’ learning. The essence of ‘learning on demand’ or ‘just-in-time’ is that such learning is in response to people’s needs in context. In other words, when people are faced with issues and problems, they are able to make sense of the situation and seek appropriate help. A demand perspective suggests the need not to overemphasize the force-feeding type of learning in which learners cannot make sense of applications of knowledge fed to them. From a practice’s 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 or her performance will be based on successful solutions.

From the perspective of learning as a social act, recent literature on situated cognition emphasizes the importance of how people socially construct meanings and appropriate social, cultural norms. Learners through legitimate peripheral participation (Lave & Wenger, 1991) "steal" implicit and explicit knowledge through participating and observing practitioners at the periphery or side (Brown & Duguid, 1996). Through a process similar to apprenticeship, learners gradually acquire skills of the trait, norms, and rules held by the community of practice. Soon, they move from peripheral to central participation (Hung, 1999).

One of the key notions of situated learning is that of appropriating “ways of seeing” from the practice. For example, through the apprenticeship process, not only are skills or rules of the art appropriated, but so are beliefs, norms, and dispositions of the masters or practitioners (Polanyi, 1964). In other words, these learners acquire a “lens” for seeing meanings that are identified with the community of practice. The identity, for example, of doctors, engineers, lawyers, etc., is evident through the genres (speech acts) used by the practitioners in each profession. Identity formation takes place through the appropriation of the beliefs, values, and skills required in a practice—seeing through the “lens” of a particular practice.

The purpose of this article is to expand upon the above three notions of learning—learning as demand driven, learning as a social act, and learning via ways of seeing—as depicted by Brown and Duguid (2000) by appropriating Vygotsky’s writings, and to draw implications for the design of Web-based learning environments. The current forms of school-based learning, in which knowledge is 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 Vygotskian thought and the communities-of-practice perspective bring back this emphasis of embedded learning in the workplace. We argue that learning on the Web may be a possible platform for situated or conceptual learning, Web-based learning is fundamentally not constrained by specific locations and classrooms, but can be infused into varying learning situations.

Vygotskian Thought

Vygotsky (1978, 1981a, 1981b, 1997) identified two tasks as basic to the analysis of a child’s psychological development: (1) the analysis of the social situation that defines the child’s life (the intermental level); and (2) 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 so-called Zone of Proximal

---

David Hung is with the Instructional Science Academic Group, National Institute of Education, Nanyang Technological University, Singapore (e-mail: widhung@nie.edu.sg).
Development, the genetic law of cultural development, and the role of sign and tool mediation.

**Zone of Proximal Development**

In 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 advocated learning and instruction as guided in the context of varying degrees of expertise within stipulated Zones of Proximal Development. In other words, learning should involve *interactions between novices (learners) and mature practitioners (more capable and knowledgeable individuals)* within the **communities of practice** (ZPD) framework (Hung, 1999).

There are indications that Vygotsky was moving away from a view in which forms of mental functioning are viewed as properties that characterize the general level of individuals’ and groups’ functioning. An implication of this is that it is more appropriate to characterize the mental functioning of individuals in terms of heterogeneity of mental processes rather than in terms of a single, general level—according to the particular individuals or social groups. Fundamentally, 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 (Davidov, 1995; Vygotsky, 1997). In essence, recognizing individual current levels of cognition and tailoring a *personalized ‘curriculum’* for the learner within the stipulated ZPD would be the ideal learning situation. The recent notion of cognitive apprenticeship (Brown, Collins, & Duguid, 1989) is one such ‘instructional approach’ used within stipulated Zones of Proximal Development.

**General Law of Cultural Development**

The “general genetic law of cultural development” lies at the heart of the Vygotskian thesis of the social formation of the mind. It theorizes the social in connection with the psychological.

According to Vygotsky, research studies should consider what the social 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. 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 a; Hung & Wong, 2000).

The above can be actualized in a setting within the ZPD, in which 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.

**Role of Sign and Tool Mediation**

Vygotsky argued that the higher mental functions rely on the mediation of behavior 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 toward the mastery of control of behavioral processes—either someone else’s or one’s own” (Vygotsky, 1981b, p. 137). With its inclusion in behavior, “the psychological tool alters the entire flow and structure of the mental functions...by determining the structure of the new instrumental action, 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 the mechanical drawings; all sorts of conventional signs; and so on.

The specific function of a psychological tool is that it permits humans, with the aid of extrinsic stimuli, to control their behavior from the outside (Vygotsky, 1978). Vygotsky draws the example of tying a knot with a handkerchief around one’s finger 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 behavior, forms of behavior in which man himself determines his behavior with the help of an artificially created stimulus means (Wertsch & Tulviste, 1996). Today, we see information appliances, for example, the *Palm Pilot*, serving as both a technical and psychological tool in reminding individuals of their appointments and tasks to be achieved. 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
function of speech, both for the adult and for the child, is the function of communication; that is, social contact, influencing surrounding individuals (Vygotsky, 1978). In other words, via 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 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).

Communities of Practice

In the same vein, Cole and Scribner (1974) challenged contemporary notions about mental development by suggesting that cognitive functioning is bound to specific contexts of social practice and that development is based on mastery of defined modes of speaking, thinking, and acting (see also Minick et al., 1993). 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 artifacts.
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.

4. Modes of thinking evolve as integral systems of motives, goals, values, and beliefs that are closely tied to concrete forms of social practice. Institutions and communities are fundamentally identifiable by their activities, practices, and tools used. Communities of practice 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 implicit knowledge which is often overlooked (Brown & Duguid, 2000). In other words, within an activity context, cognition, and thus learning, are socially distributed between persons, tools, and rules of the practice (situational context).

Context and utterances are also linked in activity within communities by speech genres (Bakhtin, 1986). "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" (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, students 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.

Transfer of Knowledge

Bereiter (1997) was particularly concerned that the progress of situated learning consists of increasingly fine attunements to the constraints and affordances of any particular situation. As a result, learning tends to become less and less generalizable to other situations.

No amount of situated learning...would get people to the moon and back. It took something more to produce that kind of transfer, and we must try to pin down what that is. Failing in that, we may face a future in which a small number of people have caught on to some secret of transferable learning, and thus are able to keep creating and adapting to new situations, while the rest of us find it increasingly difficult to cope (Bereiter, 1997, p. 287).
In Brown, Collins, and Duguid’s (1989) account of situated learning, they emphasize that through articulation and reflection in the context of multiple practice and collaboration, learners generalize meanings across contexts. In other words, transfer is anything but automatic. “People have to be looking for a relationship” (Bereiter, 1997, p. 288) intentionally. Transfer occurs when one can see a relationship based on structural, or logical correspondences. In other words, learning is to involve looking for relationships and patterns in concepts and phenomena (Hung, in press b).

**Implications for Web-Based Learning Environments**

We see Web-based learning as a common technological platform “relationship” that can span many different communities. There should be much greater synergy between schools, and practice and learning environments can hopefully interconnect learners and practitioners. After all, intentional design for transfer of school-based learning to the workplace is an important consideration. One of our arguments is that for continued synergy, teachers in schools need to have exposure to different communities of practices, perhaps through lurking and participating in Web-based learning environments of varying communities so that instruction can be of real-world relevancy. In this way, students would be able to see relationships of why they need to study particular domains of knowledge.

Table 1 summarizes the main principles describing the processes of learning as denoted by Vygotskian thought and situated cognition. Alongside the seven learning principles, we describe parallel design considerations for Web-based learning environments.

As an example illustrating the Web-based design considerations stipulated in Table 1, Figure 1 is a screen capture of a knowledge-building situation using Knowledge Forum, developed by the University of Toronto—OISE. Knowledge Forum is a second generation product (including a Web-based version) of CSILE (see Scardamalia, Bereiter, & Lamon, 1996). The current version of Knowledge Forum does not support tracking of learners’ profiles; however, it has many features which connote the principles above, for example, through social writing in communication, it capitalizes on the “mediational function of speech” as outlined by Vygotsky. It somewhat fosters identity formation by facilitating different views through which participants from different communities can interact on issues of motivational and practical concern to them. Learning is reflective in such an environment because scaffolds are created for learners to reflect in action. As a structured collaborative learning environment,
<table>
<thead>
<tr>
<th>Principles from Vygotskian Thought</th>
<th>Design Considerations for Web-Based Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. Learning is an identity formation or act of membership enculturated within stipulated ZPDs.</td>
<td>7. Web-based learning environments should create a 'structural-dependency' between individuals in which novices need more capable peers, capitalizing on the Zone of Proximal Development.</td>
</tr>
<tr>
<td>D. Learning is reflective and metacognitive, internalizing from social to the individual.</td>
<td>8. Web-based learning environments should create a situation in which there is continual growth and interaction through the tools embedded in the environment.</td>
</tr>
<tr>
<td></td>
<td>9. Web-based learning environments should be designed to capitalize on the diverse expertise in the community.</td>
</tr>
<tr>
<td></td>
<td>10. Web-based learning environments can facilitate reflection and metacognitive actions through the provision of facilitation cues or questions.</td>
</tr>
<tr>
<td></td>
<td>11. Web-based learning environments can focus on depth over breadth, thus enabling learners to analyze communicative 'speech act.'</td>
</tr>
<tr>
<td></td>
<td>12. Web-based learning environments can focus on tasks and projects, thus enabling learning through doing and reflection in action.</td>
</tr>
<tr>
<td></td>
<td>13. Web-based learning environments should be Internet or Web-based so that with such a common networked platform, learners can access the learning environments in their embedded contexts.</td>
</tr>
<tr>
<td>E. Learning is embedded in rich cultural and social contexts—acquiring both implicit and explicit knowledge.</td>
<td>14. Web-based learning environments should be portable as far as possible so that they can be used in the proper context.</td>
</tr>
<tr>
<td></td>
<td>15. Web-based learning environments should complement other forms of interaction, e.g., face-to-face, allowing tacit knowledge to emerge.</td>
</tr>
<tr>
<td></td>
<td>16. Web-based learning environments need not contain time-critical knowledge in which human skill is most valued.</td>
</tr>
<tr>
<td></td>
<td>17. Web-based learning environments should contain knowledge that can 'stay in the world,' where tools are available for locating the knowledge.</td>
</tr>
<tr>
<td></td>
<td>18. Web-based learning environments should have tools which can optimize human performance.</td>
</tr>
<tr>
<td></td>
<td>19. Web-based learning environments can challenge learners to reflect on concept principles that can be applied to other contexts.</td>
</tr>
<tr>
<td></td>
<td>20. Web-based learning environments can facilitate learning through observations of visual representations, patterns, or relatively stable variables.</td>
</tr>
<tr>
<td></td>
<td>21. Web-based learning environments can organize information so as to allow the learner to engage in further analysis.</td>
</tr>
</tbody>
</table>
Knowledge Forum has the following features promoting reflection (see Figure 1):

- **Graphical representation of learners’ notes.** Learners can pose, reflect, link, relate and question ideas posted by themselves or others, thus making knowledge-construction process overt and traceable.
- **Communal database.** It facilitates revisiting notes by storing the contributions in a common database accessible by learners using networked computers.
- **Inter-subjectivity.** Learners can build on each other’s ideas, comment, organize, annotate and connect associated notes. It exposes the users to different perspectives and often leading to construction of better ideas and concepts.
- **Customizable supports.** It provides customizable supports for discussion. For instance, in solving a problem, the student may be asked to pose notes using the following labels “My theory,” “I need to understand,” “My theory doesn’t explain,” or “A better theory.”

In knowledge building environments, the notions of transfer and ZPD have not been exploited. Scaffolds for the transfer of knowledge can be customized, for example, procedural cues such as “The common patterns of thought are,” “I see relationships to,” and “I hypothesize that this knowledge can be applied to.”

Scaffolding structures can also be applied to the notion of ZPD. Interaction between varying expertise could use like procedural cues such as: “Observe the way I construct this knowledge” connoting modeling; “You could improve on the construction process as follows,” connoting coaching; and other thinking or reflection questions posed by the more knowledgeable peer. Questions that the learner can pose include: “Why,” “How,” “When,” and “What” questions.

Varying levels of expertise within the knowledge building community can also be denoted. Currently, the common placements of participants in most learning environments are by the individual’s name. Membership in communities of practice can move from peripheral to central participation (Lave & Wenger, 1991). A continuum of participation can be of varying expertise: Novices (members without persistent identity being peripheral participants), Regulars (members have been contributing for some time), Mentors (members who make efforts to assist others and resolve problems), and Experts (members who pass on the culture of practice to further generations with clear and persistent identities.

**A Scenario**

Assume that Dave is a student in physics. He is currently engaged in some project requiring the understanding of Newtonian physics. He logs on to the Web-based learning environment—as stipulated by the principles identified in Table 1. He lurks around the community database where physicists and learners co-construct theories and understandings in Newtonian physics. Two days into the project, he is confronted with a problem. Feeling awkward about asking his peers, he decides to ask a question in the Web-based learning environment. On registering as a Novice, he finds someone else who has similar doubts and jumps onto the Regular’s question. Not finding all the answers that he desires, Dave asks a more specific question relating to his project. He strikes a conversation with a Mentor and tries to redefine his question. The Mentor brings him into a ZPD and poses further questions, leading him in a certain direction in Newtonian physics. He tries to use the Mentor’s perspective to come up with a solution. And it gets Dave somewhere.

Dave has completed his first fruitful knowledge building effort. A week goes by and Dave gets another question answered by either a Regular or Mentor. He now gains more knowledge. Soon he notices other learners posing questions, and he is able to address them. There were more people like him out there that needed help. He cautiously replies to some questions. He does not want to be looked upon in bad light. The other learners respond, and one of his opinions is judged as favorable. Dave gets his first taste as contributor. He answers some more questions. He has now become a Regular. He is constantly shifting between roles of a learner and a regular contributor. He is comfortable with that, as he is now a member of a community of practitioners doing just that.

Let us advance Dave’s learning adventure by a few years. Now, Dave is a graduate. He is put in charge of more challenging projects in the workplace. He still frequents the knowledge building Web-based learning environment, but his profile has changed a bit. He is now a known contributor. His name and picture are placed in the Mentor’s list. He still asks questions, but these are not like the easy ones he used to ask when he first joined. His questions now are those that are discussed by Experts. His place in the community has shifted. Soon he becomes a reputable player who not only answers questions but also gives free advice on products and processes of knowledge. He is an Expert now.

**Issue of Personalization**

Currently in Web-based applications on the Internet, the issue of personalization (usually automated by intelligent bots and agents) is gaining much currency. These agents observe patterns of behavior by participants in the community (perhaps judging by the different levels of contribution) and recommend personalized information and content. In other words, because there is a common identity between people of different communities and profiles, these participants...
have a high chance of similarity, the bots and agents are able to give moderately accurate displays or recommendations of content. Applied to our Web-based knowledge building context, views and knowledge notes of interest to the issues raised by the learner can be predicted and recommended.

For example, if the system knows that Dave is a Novice concerned with issues relating to Newtonian physics, the system is able to recommend similar issues and problems that others have identified, including domains outside of physics. Currently, “Knowledge Forum” does keyword searches. Such a notion can be extended to situational (or related) and distance concepts in the digital collaborative community. See Figure 2.

**Figure 1. Knowledge building in “Knowledge Forum.”**

**Conclusion**

The concepts of Vygotskian thought and situated cognition and now notions of community of practice can bring tighter integration between schools and real communities. Hopefully, Web-based environments would be able to bring contextual community of practice knowledge into the schools with the aim that our students would adequately appropriate scientific inquiry and other disciplinary “ways of thinking.”

Because learning transforms who we are and what we can do, it is an experience of identity. It is not just the accumulation of skills and information, but a process of becoming—to become a certain person or, conversely, to avoid becoming a certain person. (Wenger, 1998, p. 215)
Since it is logically difficult to bring students physically to the real communities of practice, Web-based learning environments could be virtual places where students and practitioners engage in activity. These processes when situated in rich knowledge building virtual places can foster learning opportunities that can be leveraged through collaborative participation. Of course, while students may be willing to participate with practitioners, there should be compelling reasons for practitioners to spend time and effort in mentoring these students. There should be forms of ‘structural dependencies’ or reciprocity developed between communities of practice and schools, or even forms of social recognition to be given to practitioners. These are areas of further research in order to develop Web-based learning infrastructures linked with real communities.

**References**


ID Project Management

Why a Book About ID Project Management?

As most ID professionals know, there are all sorts of models and tools available to help organize the development process. But the job of the ID project manager is not so well defined. Like any manager, the ID project manager must complete projects within limited budgets and schedules. Yet good instructional design and development principles often collide with these "bottom-line" constraints. ID project managers must therefore walk a tightrope, suspended between their own ID conscience and their management’s requirements for fast, cost-effective training. Faced with these pressures, it is difficult to create high-quality instructional materials. To be effective, a good project manager must be able to perform exactly the right management interventions at exactly the right time.

What This Book Can Do for You

By providing a conceptual framework (a management model) and the tools and techniques to make interventions within this framework, this book will help ID project managers quickly determine the proper course of action at any point in the development process.

Specifically, this book presents 37 different tools (worksheets, guidelines, checklists) and describes how you can use them to get concrete answers to questions like these:

• What are the types and amounts of instructional materials we will need to develop?
• How long will it take to draft, revise, test, and produce these materials?
• How much will it cost (i.e., how much should I budget) to develop these materials?
• What are some specific roles and responsibilities I should assign to each member of my development team?
• What events should I include in my project schedule?
• What are the critical components of a Project Diary?
• What specific directions should I provide reviewers and subject matter experts (SMEs) when they review drafts?
• How do I organize and execute a "test run" of my materials and then conduct an effective debriefing of participants?

If you plan, manage, or help manage ID projects, this book is likely to save you time, frustration, and money by helping you make sure your ID team gets the job done right the first time.