METAPHORICAL IDEAS AS MEDIATING ARTIFACTS FOR THE SOCIAL CONSTRUCTION OF KNOWLEDGE: IMPLICATIONS FROM THE WRITINGS OF DEWEY AND VYGOTSKY

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ABSTRACT

Complementing the Deweyan concept of "idea-based social constructivism" with the Vygotskian notion of 'psychological tools', we claim that metaphorical ideas are powerful mediating artifacts (psychological tools) for the internalization of concepts. The paper supports such a premise by describing, through Conversation Analysis, how (pre-service) teachers co-conceptualize appropriate metaphors (in a multimedia instructional design course) that would aid in teaching scientific concepts to elementary (grades 1 to 6) school children. As these metaphorical ideas are brought to the public arena, a negotiative process is undertaken. Such a process facilitates the evaluating of the inter-relationships of the metaphor with the concept(s) to be taught. Through situating or applying the metaphor in the design of an actual lesson, students substantiate the metaphor in context.

In this paper, we attempt to discover some insights into the Deweyan notion of idea-based social constructivism (Prawat, 1996, 1999). Broadly speaking, ideas can be metaphorical in nature and socially authored. By socially authored, we mean that these ideas are co-constructed within the context of social-cultural underpinnings. For example, human cognition as an information processor has the Computer as a social-cultural metaphor resulting from societal (technological) influence. Our central thesis in this paper is that metaphorical ideas serve as mediating artifacts between the social-public and individual-private arenas. In other words, from our understanding of Vygotskian psychology, ideas serve as intermediaries for internalization from the social to individual levels of cognition. Vygotsky's general genetic law of cultural development states:

Any function in the child's cultural development appears twice or on two planes. First, it appears on a social plane, and then on the psychological plane. First it appears between people as an interspsychological category, and then within the child as an intrapsychological category.... Social relations or relations among people genetically underlie all higher functions and their relationships. (Vygotsky, 1981, p. 163)
We will describe such a premise through a case study of a group of pre-service trainee teachers in the design of a multimedia instructional project for the teaching of elementary (grades 1 to 6) school concepts.

**THEORETICAL FOUNDATIONS**

Dewey (1933) illustrated that ideas have the potential of arousing an alert mind, carrying students to new fields, branching out into new ideas as a plant sends forth new shoots. Ideas also help students to see meanings in a new light and with a new understanding. Dewey expresses the value of playing with ideas:

[N]othing is more fascinating than to follow out the relations of concepts and, by discovering unexpected relations among them, see them unfold into a harmonious system whose contemplation gives great esthetic satisfaction. There is such a thing as playing with ideas ... it promotes a constructive, although unconscious, playing with meanings in their relations. (Dewey, 1933, pp. 182-183)

Dewey also expressed the social constructive dimension of idea generation as ‘to anticipate’ knowledge together (Dewey, 1925/1981). The writings of Dewey suggest that discoveries and new horizons of knowledge spring from novel ideas co-authored by individuals and through group negotiations. Such a negotiation process is probably of unequivocal importance in social constructivism (Prawat, 1996). Through negotiation, students are usually engaged in explaining their ideas, defending their opinions, and trying to convince others of their thoughts. Through such a process, students can establish shared meanings or intersubjectivity. In other words, playing with ideas can be a social constructive process or perceived as the co-playing of ideas.

**Metaphorical ideas**

Metaphorical ideas are used as a comparison of concepts by relative assertion describing one concept in terms of something else. According to Lakoff and Johnson (1980), “The essence of metaphor is understanding and experiencing one kind of thing in terms of another” (p. 5). Sternberg (1990) uses various metaphorical ideas, for example, geographic, computational, biological, epistemological, anthropological, and sociological metaphors to connote the mind. The purpose of using these metaphors is such that through making associations and comparisons with ‘something’ else, the concept to be understood would be made clearer or in more familiar terms. Such a process may be termed abduction (Prawat, 1999).

One startling idea developed out of Albert Einstein’s careful reading and discussion of a classic earlier experiment described by Faraday (Miller, 1987). In that experiment, the theoretical account of electromagnetic induction varied depending on whether a conductor or a magnet was used as the reference point. Faraday’s description of the experiment, Einstein later wrote, played a leading role in the development of his own thinking. He hypothesized that since the theoretical interpretation of a fundamental phenomenon like electromagnetism is relative to one’s frame of reference, such a phenomena may be true of Newtonian physics (Miller, 1987).
Metaphorical ideas are also inherently pedagogical in the sense that, once understood, they immediately impress us with their heuristic power—‘that is, their’ ability to provide epistemic access (McEwan & Bull, 1991). Metaphors draw the relations between words and propositions. As described above, metaphors play a pedagogical role in science, helping to sell new ideas by providing vivid or concrete relations and ways of representing those ideas. Its utility is based entirely on the extent to which it sheds light on new features of an important phenomenon (Prawat, 1999).

Abduction—the process for generating ideas—is a metaphoric process. As such, it possesses a key attribute described by Turbayne (1970)—it consists of old and new meanings. Turbayne’s notion that metaphors encompass a “duality of meaning” (p. 103) fits nicely with Dewey’s way of talking about ideas. Ideas are instruments of knowledge that connect the old and the new, the known and the unknown. Prawat (1999) provides an example:

[A] student might realize that a plant, as a living thing, needs food to survive just as the student does. The teacher, at this moment, introduces a dramatic metaphor, pointing out how leaves on the plant function as miniature food factories. The student immediately sees how this solves the source of food problem. The world of green leafy things has thus been dramatically opened up for the student. (Prawat, 1999, p. 60)

The metaphor food factory, which a teacher might use to get across the scientific concept photosynthesis, conjures up the image of a series of relatively self-contained units that specialize in the production of certain essentials. On the basis of this image, a student would initially expect to see certain things in using this metaphor to better understand the uniqueness of green, leafy plants. For example, the student might assume that the respiration of a leaf is just as observable as the discharge of smoke and gas from a factory. Still, a student would expect to find structures analogous to such things as the factory warehouse where the products of the leaf factory are stored. Similarly, the student might look for by-products (i.e., oxygen) that are produced in addition to the principal products, as in the case of factory production. (Prawat, 1999, pp. 62-63)

Abduction involves reasoning from the known (rule) to the new or unknown (case) by way of metaphoric leap or projection (Prawat, 1999). Hence, abduction consists of studying facts and trying to devise an explanation or theory undergirding them (Peirce, 1934, Vol. 5).

Similarly, Dewey (1925/1981) believed that the role of learning is to bridge the inherent tension between known and unknown in a dialectical or transactional process. Ideas can be the main instruments of that activity. Ideas, or rather the metaphoric-psychological signs that instantiate ideas, connect the old and the new. This double meaning is represented at one end by iconic representations that connote the new knowledge, and at the other by the yield the learner realizes from cashing in on the old knowledge. Rochberg-Halton (1986, p. 68) explains: “An iconic perspective means that the immediate qualities of experience can also act as mediating signs or sources of information, not reducible to convention alone.”

According to Peirce, there is a perceptual or insightful element to abductive thinking. This form of reasoning is very important in the early stages of the metaphoric process. Here, Peirce argues, one must be open to possibility: “The elements of every concept enter into logical thought at the gate of perception” (1934, Vol. 5, p. 131). In other words, perception and idea generation are closely related.

The judgmental element of abductive thinking, which occurs a little later, involves some control as one scrutinizes ideas. Judgment enters in at the later
stages of idea construction, as one moves beyond considering what is possible and attempts to actually test the feasibility of the new idea and ascertain how it fits with a series of related ideas: “Impression soon passes into attentive observation, observation into musing, musing into a lively give and take of communion between self and self,” Peirce writes (1935, Vol. 6, p. 314). Here Peirce complements Dewey’s notion of argumentation between self and other-selves.

As indicated, when ideas first originate, as mere possibilities, certain anticipations or expectations about the quality of subsequent experiences are also being created. A second stage continues where considerations are made as to how well the sign delivers on its actual promise. This quality, Peirce (1934, Vol. 5) argues, reflects the fact that one is aware of how the sign both fits and does not fit the referent. Finally, at a third stage, attention turns to a broader set of issues. The question now becomes one of how well the new idea, which clearly has potential for illuminating the referent in question, relates to other similar concepts. We characterize the three stages as generating, negotiating, and situating of metaphorical ideas.

Here, the processes of negotiation and situating are particularly important. Personal verification (through situating), Dewey writes, though not supplanting social verification, is an important part of the process, constituting “an encouragement, an authorization to go ahead” (1912/1979, p. 77). The discourse community, however, is the final arbiter of how an idea fits in the larger scheme of things. In this sense, Peirce also falls under the social constructivist school of thought. Both Peirce and Dewey assign a high priority to social interaction in helping individuals conceptualize and test-situate ideas. “The very origin of the conception of reality,” Peirce argues, “shows that this conception essentially involves the notion of a community” (1955, p. 247). In other words, the community sets the ‘public criteria of meaning’ (Wittgenstein, 1958).

Cobb (1994) suggests that public and private approaches ought to be viewed as complementary. Each, he argues, tells “half of a good story” (p. 17). Teachers must attend to both the public and private ways of knowing at the same time—both group and individual learning. Teachers who wish to experiment with abduction as a way to develop big ideas in the classroom obviously must give a great deal of thought to the quality of the metaphors they present. One way to get a handle on this task is to trace the disciplinary history of each idea, examining what sorts of metaphors give rise to each idea and how these were modified and refined as the ideas gained more and more currency. Such a historical perspective is congruent to the Vygotskian social-historical method (Davydov, 1995).

Not all ideas are equally powerful, a fact that teachers often fail to take into account when they emphasize big ideas in their instruction, a relatively rare occurrence according to one analysis of the classroom situation (Prawat, 1993). Powerful ideas developed within the discipline (e.g., photosynthesis) are prime examples of ideas that have the ability to move on their own accord (Dewey, 1933). These ideas, Dewey writes, represent experience “in a more regulated and significant form” (1925/1981, p. 24). They open students up to aspects of their environment in ways that are truly expanding.
Ideas as mediators between the social and individual levels of cognition

To reiterate, within the Vygotskian perspective, ideas (psychological tools) can be seen as mediators between the social-community and individual levels of cognition. Concomitantly, we earlier mentioned Rochberg-Halton (1986) iconic perspective of ideas and how they act as mediating signs. The sign is located outside of the organism just as a tool is a social artifact embedded in a super-individual, objective and cultural world (Davydov, 1995). On the other hand, when internalized, the sign also exists in the consciousness of the individual subject.

Research in social-cultural psychology also includes the notion of mediation of behavior through cultural signs and artifacts (e.g., Wertsch, del Rio, & Alvarez, 1995). The starting point is enhanced and enriched with Bakhtin’s (1981, 1986) notion of social language, speech genre, and dialogic voices within communities (see Wertsch, 1995). The central concepts in consideration are community of practice and participation. Practices and work are investigated on the same level with interaction and sign-mediated communication (Cole, Engeström, & Vasquez, 1997). Hence, within the activity-community structure, ideas as artifacts mediate the discourse at the social level. Within such a notion, appropriation of meanings or ideas at the discourse level becomes internalized into the individuals.

The history of the use of the appropriation term (prisvoenie in Russian) goes back at least to Marxist thought. Prisvoenie refers to a person taking over (more exactly: assigning something to) oneself, as well as somebody else assigning something (or promoting something) to the person (Valsiner, 1998). According to Valsiner’s (1998) interpretation of the writings of Leont’ev: “the individual person is encoded as the active agent who makes something that was not one’s own into something new that belongs to the person, albeit in a novel form” (Valsiner, 1998, p. 106). In addition, the notion of appropriation has also been much attributed to the Russian literary scholar Mikhail Bakhtin. Bakhtin’s (1981, 1986) explicit emphasis is on the active role of the person-who is the agent who makes the alien (somebody else’s) word to be one’s own. The use of the term prisvoenie guarantees the personally active, yet bi-directional, nature of the appropriation process. Thus appropriation takes place largely in the context of social others (Hung, 1999). Hence, in essence, appropriation is the active dialectical assimilation and accommodation of some idea, concept, or word that was once alien and now one’s own, albeit in a novel form. In other words, when ideas are brought out to the social intermental level and negotiated upon, these ideas can be appropriated by the active learner in a novel form which is not fully identical to the original idea.

Such a process of appropriation is important because it stresses the notion of activeness. Vygotsky proposes the educative process as active in three ways: the student is active, the teacher is active, and the milieu which they have to socially construct knowledge is also active (Davydov, 1995). Before internalization occurs, there is the phenomenon of active appropriation from all parties within the social construction process.
In the next section, we describe Conversation Analysis as a methodology used in our case study revolving around a social construction context. Conversation Analysis is a methodology supporting the situational context of an activity structure centering around participants in conversation.

**METHODOLOGY OF CASE STUDY**

A methodology supporting social constructivism, and the philosophical underpinnings of conversation and negotiations situated within cultural activity contexts, is *Conversation Analysis* (CA) which is grounded on ethnomethodology (Garfinkel, 1967). Ethnomethodology attempts to consider the *contextual* nature in which everyday activities are based, focusing particularly on 'participant categories.' One central claim of this study is that conversational interaction enables students to construct relational meanings incrementally. Specifically, it is argued that conversational interaction provides a means for students to construct increasingly sophisticated approximations to scientific concepts collaboratively, through gradual refinement of ambiguous, figurative, and partial meanings. The basis for this claim is research in conversation analysis (CA) and pragmatics (Goodwin & Heritage, 1990; Levinson, 1983). Moreover, CA research shows that meanings can accumulate incrementally, subject to ongoing repairs (Schegloff, 1991). It has shown how convergent meanings can be achieved gradually through collaborative interaction. Convergence in meanings is achieved through cycles of displaying, confirming, and repairing shared meanings. A greater degree of sharing is gradually produced by joint use of meanings in situations that require progressively more constrained actions ill order for attributions of shared knowledge to be warranted.

The most elementary instance of conversation occurs when some current individual's talk or conversation projects a relevant next activity, or range of activities, to be accomplished by another speaker in the next turn or response in discourse. Such a phenomenon is generically referred to as the "sequential implicativeness" of a turn's talk (Schegloff and Sacks, 1973). The sequential next positioned" linkage between two actions can be a critical resource by which a first speaker can determine the sense which a second speaker made of his or her utterance. Thus, in conversation, what looks on the surface to be a series of discrete, successive "turns" is actually a process of continuous, simultaneously reflexive behaving and monitoring by two players. Through such reflexivity, the conversation can be said to be jointly produced by its participants (Erickson, 1980).

It remains for us in the subsequent section of this paper to describe our case study and report on the findings through conversation analysis methods.

**CONTEXT OF CASE STUDY AND BACKGROUND OF RESEARCH SUBJECTS**

The students engaged in our study (see Hung, 1998b) were year two pre-service teachers from our undergraduate course at the National Institute of Edu-
cation (Singapore). The objectives of the course include conceptualizing appropriate metaphors for the teaching of elementary school concepts. The outcome of the course was a multimedia instructional design project.

As class time was limited to two hour slots once a week for a period of only 9 weeks, we recognized that supporting infrastructure, in terms of tools, must be accorded to facilitate the social construction of knowledge. These computer-mediated tools serve as scaffolds for the social constructivist learning process. We introduced PictureMail™ emailing facility where multimedia oriented idea-artifacts can be channeled to other students for commenting. PictureMail™ allows multimedia interactional capabilities, combining text and graphics. Students could comment on different portions of the metaphor using the tool. In addition, we also facilitated the broadcasting of students’ projects for class time discussions. We felt that students must be encouraged to “socialize” through different means as far as possible.

From our study (see Hung, 1998b) the data collected from the students themselves include video recordings, multimedia electronic mail discussions, drafts of student projects at different stages of their creation, and summaries of the design concepts learned. As instructors of the course we are participant observers and our data include classroom observations and informal discourse with our students.

Case Study

The following protocol represents one in-class project discussion. Having conceptualized an appropriate metaphor for their projects, students develop an initial multimedia project prototype. “I” represents the instructor, “SP” denotes the student presenter, and “S1”, “S2”, “S3”, “S4” are the pre-service-teachers participating in the discussion. Comments in denote the author’s comments.

Protocol for the ‘Magician’ Metaphor

In this protocol, the pre-service teacher (SP) was designing a multimedia lesson for elementary school students relating to the concept of changes in states, position, and sizes.

I: Identify why your metaphor used is good or otherwise; and maybe ask for feedback why it is not so good, how to improve ... Your contribution in class will help in your assessment.

SP: I will be doing a topic on changes. Basically, the focus is on the different type of changes, e.g., change in shape, size, position and, state. The change from solid, liquid, gases.

SP: Basically our metaphor, right is a magic show.

At this point, the student presenter, SP, had generated a ‘magician’ metaphor depicting changes in state. The following protocol further describes the process of developing, applying, or situating the magician metaphor as part of the lesson.

SP: If the students [school students learning from the lesson] come to this slide right, they will be able to click on either of the 3 rabbits. The 3
rabbits symbolize (not in any order), state, size, position ... for every change right, every type of change, we will have 2 examples to show that change.

Here, the context is such that the ‘changes in state are presented by a illia-ician with the use of rabbits. The rabbits symbolize the change in state, size, and position. Predominately, rabbits are common scenes in a magic show. Here we recognize that the use of this familiar metaphor for children Would aid them in relating the above three concepts.

SP: The student should not be told directly, i.e., say that this is a change in what [the change is done visually but not explained in words]. In these slides, we do allow the teachers to stop at those points and ask the students for answers, asking them what kind of changes. Obviously, this is a change in state, ... when they show that the ice-cream melting from solid to liquid. This one we have this frozen lake that changes to become a lake itself.

The student presenter (SP) felt that a better form of instruction here was to allow the student to construct an interpretation of the change rather than to provide ‘direct instruction’ as to the change. For a change in state, an ice-cream melting is used to illustrate the change from solid to liquid. Similarly, artifacts such as ice-cream can be used by a magician. Here, a change in position is illustrated as follows:

SP: Now shows a change in position. They have to click on to see that the food has changed in position. Now, they will click on the sausage and it will run.

After the student, SP, presented, we invited the class to respond by giving feedback on the metaphorical idea and design. We denote the instructor’s role here as scaffolding, students’ thinking.

I: O.K, so what do you think of this presentation? What do you think of the metaphor that was used? The magician that can change shape and sizes ... so on and so forth ...

At this state, a student, S1, responded to the choice of metaphor used. S1 felt that the metaphor of a magician was a good choice as it depicted the context of ‘change.”

S1: I think the metaphor is a very good one. Because there are a lot of changes and then they made use of the magician and the context, you see, for teaching the changes. Because the magician is basically is to perform changes, so, in one sense, it is very natural to use a magician. In that sense, I think the metaphor is quite good.

There was general agreement of S1’s point. However we wanted students to think more deeply into the issues of what makes a good metaphor. The point we wanted to portray to the class was that the use of metaphors should have a direct bearing to students’ learning.

I: So, do you think that the school students [learning from the project] will understand the changes in shapes? ... Any other comments?

S2: The rabbit growing big right, there is this effect called the zoom, so, ya
...so click on the rabbit, this zoom out feature. This shows the change in size. It is very nice.

S2: comments that the zoom effect made by the software was very nice as it illustrates and has a direct bearing on the change in effect.

S3: Instead of using the rabbits right, we can use the names that represent the states for each of the rabbits.

SP: We don't want to tell them [students] what is it. We want them [students] to find out.

S4: Then, you can give other names to rabbits, you see.

I: Unless there are certain character names that identify, um, when something is big, something is small, you know, like maybe Donald Duck—very skinny or what ever certain names that people can identify with will be also quite adequate.

In order to minimize confusion as to what each of the rabbit performed (as commented by S2), S3 and S4 suggested different ways to differentiate the functions of each of the rabbits. S3 suggested naming the rabbits according to the state performed, of which, SP noted that the intention was for students to 'find out' for themselves concerning the state change. Recognizing the appropriateness of SP's instructional intention, we suggested naming the rabbits with appropriate denotations. With these comments, SP had to appropriate the comments provided. Another concern was the use of sound.

I: Another concern is the use of sound. What do you all think about the sound?

S4: I think that when the change, when there is change going on for example, from the small size to the bigger size, that sound, I think is adequate, is appropriate. Because it gives a feeling of magic taking place, so I think it is O.K.

Here, S4 supported the use of sounds for each of the change effects, indicating that the sound effects strengthened the 'magic taking place.' Before we finished commenting on SP's multimedia project, were asked for comments which required self-reflection.

I: Are you all satisfied? Any other things before we move on? Any? Feel free to comment.

SP: It is not really that fantastic, there are still a lot of improvements to be made.

**DISCUSSION**

The above protocol example on the magician metaphor illustrates the simple but effective use of metaphors in relating concepts to children using familiar notions and ideas. Basically, when a metaphorical idea is presented, it has to be illustrated by actual situating or applying into the concepts at hand, for example, the rabbits used for state, size, position. Notions of 'artifacts' used in a magic show (e.g., hats, and rabbits) help to concretize and relate the concepts to be learned. We would denote such a process as abduction.
When the class was asked to comment on the metaphor, there was general agreement that it was good because they could see a direct relationship between changes and magic. In other words, there was intersubjectivity with the community's views. The further suggestions from the class was in improving details of the metaphor in relation to the lesson content, for example, whether the rabbits presented could be better labeled. These suggestions in other words attempt to validate the appropriateness of the metaphor. Importantly, we recognize that although metaphorical ideas may begin as an iconic or pictorial perspective, language plays a subsequent role in validating its details. As expressed earlier, both Dewey and Peirce stress the extent to which idea construction is a social process which involves developing shared expectations about the quality of the experience individuals will have when they view reality through the lens of the new idea.

However, one would have recognized that viewing an idea always depends on a social cultural lens. In other words, conjectured ideas are culturally influenced. In our example, students are assumed to understand a magic show - a phenomenon probably observed either through real-life shows or through the mass media. According to Vygotsky (1978, 1981), culture provides more that just a setting in which learning occurs. Instead, it is the culture that lays the foundation of all knowledge. All signs, symbols and tools are deeply rooted in particular cultures. Thus, learning occurs in a manner that is directly fostered and developed by the culture. Culture is in fact the product of human social life and the social activity of human beings.

Vygotsky also believed that the human mental abilities develop through interaction with the world. This interaction is mediated by the use of culturally based signs, symbols and tools. And further, it is these very signs, symbols and tools that shape the structure of higher-order mental functions (Vygotsky, 1981; Vygotsky & Luria, 1994). This creates a cycle of development that comes to embody a culture. Hence, metaphorical ideas constitute a mixture of cultural signs, symbols, and tools. The magician's symbols and tools are rather generic in the western culture, e.g., hats, rabbits, etc. Obviously, the most significant sign is magical change.

**Ideas as mediators between the social and individual levels**

Since metaphorical ideas are psychological signs they constitute as mediators or artifacts at the social cultural level of discourse and cognition, according to the Vygotskian perspective. In other words, metaphorical ideas are 'psychological tools' which influence mind and behavior.

Ideas and meanings all necessarily relate the individual and the social world of which the individual is part, for they are all evolved from within the sociocultural context. The use of psychological tools is a joint collaboration between the developing learner and the culture in which he/her is developing, with the assistance of those who are already more competent in the use of those tools and in culturally appropriate goals (Hung, 1999). In other words, idea-based psychological tools have a mediational role in an activity-community context.

More specifically, Vygotsky was also claiming that humans are able master
their actions and even themselves from the "outside" through symbolic, cultural, and idea-based systems. All systems allow a child to internalize language and develop higher mental functions for which language serves as a basis. Hypothetically, qualitatively different mediational means—such as ideas—may result in qualitatively different forms of higher mental functioning. Hence, we support the claim that ideas are powerful psychological (or cognitive) tools (or artifacts) that can be recognized as aids for developing and controlling higher order functions and behaviors from the social level and subsequently influencing the individual level.

In this paper, we also suggest that ideas serve the same function as language and speech, which mediate social activity. Within the Vygotskian analysis of the semiotic mode of mediation, speech (the most powerful and pervasive of semiotic devices), functions as a psychological tool in the construction of the individual mind. According to the Bakhtinian notion:

All the diverse areas of human activity involve the use of language.... Language is realized in the form of individual concrete utterances (oral and written) by participants in the various areas of human activity. These utterances reflect the specific conditions and goals of each area... thematic content, style, and compositional structure are inseparably linked to the whole of the utterance and are equally determined by the specific nature of the particular sphere of communication. Each separate utterance is individual, of course, but each sphere in which language is used develops its own stable types of utterances. These we may call speech genres. (Bakhtin, 1986, p. 60)

In other words, metaphorical ideas can be perceived as context and culture bound language genres. Context and utterance are linked in activity in this definition of genre (Bakhtin, 1986). Talking mathematics or 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 languages are social resources for making social meaning. They are also specific genres and semantic patterns of any discipline of study. In the same vein, metaphorical ideas are semantic patterns and genres derived from specific practices in the process of meaning making.

Metaphorical ideas can be perceived as distinct ‘speech genres’ (Bakhtin, 1986) peculiar to the context of any disciplinary community (Hung, 1999). These speech and idea genres are situated in their meanings and a conceptual understanding of these genres may lead to transfer or generalization to other contexts. Through such conceptualizations, students develop a way of seeing (Hung, 1999) or ‘cultural toolkit’ (Cole, 1996) of metaphorical ideas. The richness of such a toolkit in essence determines the ability in any particular learner in a discipline. These ideas are similar to the notion of stories, practices, and rituals within a culture.

Bruner (1996) similarly claims that education is about transmitting beliefs and practices of culture. He points out that education should provide the balance between teaching specific beliefs and providing learners the "culture's toolkit" through enculturation-entering and picking up the values of a community or culture by practicing the 'trade of the community'. The toolkit includes a variety of tools a given culture uses to make sense of the world, such as culturally-developed representational systems, technologies, and ways of thought.

To Bruner, the goal of education is then to help students to use the culture's
toolkit of meaning making and reality construction. Bruner’s Cultural psychology has its foundations in the Soviet psychology of Vygotsky, Leont’ev, and Luria (see Bruner, 1996; Cole 1996). In other words, there may be a need to enculturate learners to think metaphorically within a cultural community and disciplinary context. Such a process of enculturation could evolve is we have frameworks for learning and instruction relating to idea-based social constructivism.

**Proposed framework for idea-based social constructivism**

From the literature review and the observations of the protocol data collected in our study (see Hung, 1998b for full details of the study), we recognized that students were engaged in generating, negotiating, and situating ideas and meanings related to metaphors and their related concepts. On the other hand, instructors were mostly involved in scaffolding the knowledge to be acquired by students. One central focus behind the generate process is the initiation of new and novel suggestions and metaphorical ideas for instructional design.

*Negotiation* provides the opportunities of providing feedback to one another. In this negotiation process, shared meanings are also established. However, it is noteworthy to consider that not all negotiations lead to productive discourse. Intersubjectivity or the establishment of shared meanings need not indicate that the level of negotiations is appropriate. The blind can lead the blind and negotiate meanings “blindly,” although intersubjectivity is established. What is important is that the level of shared meanings is adequate and meaningful (Hung, 1998a, 1999). In such a context, it is necessary that in the social constructivist process, there exist peers, teachers, or instructors with different perspectives that can lead the ideas generated to reasonable conceptualgrundings.

In the course of trying out their ideas, students had many opportunities to apply or *situate* the knowledge that were conceptualized. Through the situating process, students’ would be able to personally apply these ideas and instructional strategies mooted. Without opportunities to situate their learning into authentic tasks and contexts, students would not be able to experiment with the conceptualized knowledge derived so as to gain personalized knowledge that is generalizable (Hung, 1998a, 1999, in press).

Whilst there are the processes of generate, negotiate, and situate of meanings, there is also the need to scaffold students in their interactions. In the protocols illustrated above, the process of scaffolding was needed to provide guidance to students so that they could consider the implications of their discussions in relation to their metaphors and concepts to be taught. It was also necessary to scaffold students’ thinking and construction processes towards meaningful ends.

In retrospect, we recognized that our pre-service teachers learned through various means, namely: (1) observing the discourse made by instructors and other classmates; (2) making contributions to the negotiation efforts; and (3) applying their understanding into the project they were engaged in. We conjecture therefore that one can internalize concepts by observing and appropriating conceptual metaphorical ideas discoursed by others. If students formulate opinions (whether externalized or otherwise) based on what they hear, they exhibit thinking which
reinforces their learning. Moreover, if they externalize their opinions, they may be able to receive feedback from negotiations. Such feedback can become internalized through active assimilating and accommodating (appropriation) of the knowledge discoursed.

Although much negotiation between students is encouraged, we conjecture that the teacher plays a central role in steering and facilitating the discussions and externalizations made. A more knowledgeable individual (i.e., a teacher or more knowledgeable peer) is needed to concretize the discussions, bringing knowledge constructions to a reasonable 'standard' usually determined by the community of practice.

In summary, it seems that the processes generate, negotiate, and situate of metaphorical ideas is congruent to the Deweyan notion of idea-based social constructivism. The teachers' or more capable individual's role in this process is in scaffolding the generating, negotiating, and situating of metaphorical ideas, covalidating the 'criteria' of metaphors according to established norms by the community of practice.

Putting the above thoughts together into an activity structure, we have the following framework. Using the notion of an activity structure (Cole & Engestrom, 1991; Hung & Wong, 2000), we have the following processes (see Figure 1 below).

**FIGURE 1. PROPOSED FRAMEWORK FOR 'IDEA-BASED SOCIAL CONSTRUCTIVISM'**

![Diagram showing the framework for idea-based social constructivism.]

From Figure 1, metaphorical idea-artifacts mediate between subject (pre-service teachers) and object (which is the objective of understanding elementary concepts). Mediating between individual-subject and the social-community (teachers and students), we have actions facilitating their meaning constructions. In our case, the action is to work out different inter-relationships and associations between the proposed metaphor and the concepts to be taught. Mediating
between the community and object, we have the division of work processes—which are the generating, negotiating, and situating processes which are needed. Teachers facilitate and scaffold the above three processes. Accomplishing the activity leads to the outcome.

**Implications for the use of technology**

Certainly technology can also facilitate students’ playing with ideas and teachers’ scaffolding of these idea negotiations. We have also conceptualized different kinds of technologies that could support conjecturing, negotiating, and situating of ideas (see Hung & Chen, 1999). Epistemic structures for each of the three processes can be conceptualized. For example, brainstorming strategies and structures can be used to scaffold students’ conjecturing or generating of ideas.

In essence, multimedia e-mailing interactional facilitates the generation of metaphorical ideas. Epistemic tools and concept mapping tools can further enhance the negotiative process of evaluating the viability of a metaphorical idea. From the environment we provided for students, they could activate tables, lists, and other mind/concept-mapping tools for compare and contrasts of inter-relations between concepts and portions of the metaphor. In other words, interactional tools can facilities the co-generating, and co-construction of ideas. However, situating ideas need the specific tools, for example, authoring software to create and apply the metaphor into the design of the project lesson. Another role that technology can facilitate is in the organizing of comments generated in the social constructive process. The organizing process comes in particularly useful in the generation and negotiation phases of metaphorical ideas.

**CONCLUSION**

Vygotsky’s 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 towards the mastery of control of behavioral processes. With its inclusion in behavior, the psychological tools alter the entire flow and structure of the mental functions. If metaphorical ideas are powerful psychological tools, much research and work remains in exploring its potential in learning and instruction.

Complementing Vygotskian thought, Dewey offers a compelling case for ideas as opening up aspects of the world - as a plant that sends forth new shoots. Hence, ideas are signs rich with cultural meanings which bridge between the old and new. Ideas are possibilities that “instigate and direct” the “operations of observation.... They are proposals and plans for acting upon existing conditions to bring new facts to light” (Dewey, 1938/1986, p. 116). In other words, if learning is a process of interacting with the world at the social intramental level, ideas are instruments for that transaction. Understandingly the inter-relationships and functionings of that metaphorical idea (when it relates the old and the new concepts) leads to the appropriation of that idea into the intramental level.
Although metaphorical ideas can be conjectured by individuals, but when the ideas are brought out to the social community, the validity of each idea in relation to the concept it tries to connote is negotiated and substantiated.

Finally, individuals construct and appropriate their own metaphorical sense from socially available meanings within the context of activity structures denoted as 'Idea-based social constructivism'. Metaphorical ideas can serve as artifacts mediating between the social-activity-community level and the individual-activity-personal level. A rich understanding of the historical evolutions of the metaphorical ideas within a community of practice would lead to greater appreciation of that practice. Students and learners can develop ways of seeing (cultural toolkit) disciplinary knowledge if exposed to such metaphors.

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