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Activity Theory as an Instructional Model:
A Case Study of a Computer-Mediated Support System in Interdisciplinary Project Work

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Interdisciplinary project work or interdisciplinary project-based learning places demands on learners and teachers that challenge the traditional practices and structures of modern day schooling. Learning from doing complex, challenging, and interdisciplinary authentic projects requires resourcefulness and planning by the student, tools that support knowledge construction and representation, mechanisms for collaboration and communication, and support for reflection and authentic assessment. This paper argues that activity theory provides an appropriate framework for interdisciplinary work, in particular, the emphasis on (a) intended goals to be achieved; (b) subjects involved; (c) the mediating artifacts; (d) the rules of accomplishing the activity; (e) the community (teachers, experts, and students); (f) and the division of work involved in the project. Computer-mediated supporting environments should attempt to model the activity structures, tools and sign systems, socio-cultural rules, and community expectations (which are commonly interdisciplinary) that subjects or learners must accommodate when acting on some object or goal of learning. After explicating assumptions of activity theory, we describe components of a computer-mediated environments for supporting interdisciplinary and authentic work. These components generally support planning, knowledge construction, collaboration, and assessment. The paper proposes a possible prototype design based on the activity theory framework and discusses the managerial and implementation functions of interdisciplinary work within the proposed system.

## Introduction

The recent thrust of the Ministry of Education (Singapore) in developing students who can take on the challenges of the 21st century has resulted in several opportunities and possibilities for research. Students are being encouraged to possess an enterprising spirit with the ability to think critically and creatively so that they can become "knowledge-based engineers" in the coming millennium. More recently, the Ministry of Education has also introduced Interdisciplinary Project Work in the hope of promoting thinking and encouraging students to engage in authentic or real-life problem solving with concepts which span different subject disciplines. Learning from doing complex, challenging, and interdisciplinary projects that reflect real-life situations requires resourcefulness and planning by the student. The tools that support knowledge construction and representation, mechanisms for collaboration and communication, and support for reflection and authentic assessment are some of the areas needing emphasis to meet the challenges of Interdisciplinary Project Work or IPW. Hence, we submit that the time is ripe for us to engage in research relating to interdisciplinary project work and thinking in Singapore schools.

In the past, schools have been highly structured according to traditional classrooms and subject disciplines; however, educators are now challenged to transform schools into places where students can encounter meanings and knowledge, and build skills by engaging in authentic, context-based inquiry. For example, if students are to think like scientists, they should learn by observing and doing scientific work, by being engaged in a community of knowledge seekers and by being challenged to solve problems that enrich themselves and their communities (Laffrey, Tupper, Musser, & Wedman, 1998). Without new processes and support tools, inter-disciplinary knowledge explorations involving communities of learners would be inhibited.

In this paper, we propose activity theory (which has its origins in classical German philosophy of Kant and Hegel and later emphasized in the more contemporary philosophy of Marx and Engels and the Soviet cultural-historical psychology of Vygotsky, Leont'ev, and Luria) as an instructional model for interdisciplinary project work. As a case study, we propose a Computer-Supported Interdisciplinary Project Work (CS-IPW) system (Internet-based) which depicts a possible prototype of how students can be engaged in communities of learning similar to authentic practices. The paper also describes the research questions, methodology, and plan to pilot the above computer-mediated system to schools in Singapore.

# Theoretical Foundations

Traditional schooling represents real phenomena and processes at a high level of abstraction where knowledge is divided into subject matters and grade levels, and further subdivided into lessons, chapters, drills, and the like. Such abstraction and over simplification may allow students to grasp procedures and other artificial school-based heuristics (commonly derived for successful achieving in examinations), but at the cost of attaining inert knowledge. Instead, educators are currently arguing for learning of knowledge that can be both productive and useful in particular and diverse contexts (Collins, 1996). Researchers are also arguing for learning to be situated in rich contexts because robust or useable knowledge can be appropriated by engaging in tasks and situations that are authentic (Brown, Collins, and Duguid, 1989). Moreover, learning which beings in rich situated contexts can be 'transferred' if intentions to decontextualize or generalize the concepts or knowledge constructions across situations are made (Bereiter & Scardamalia, 1989). Authenticity in school curricula can be supported by investigations that are open-ended, answers that are not pre-defined by any particular perspective or discipline, and that students can be engaged in the social construction process of knowledge.

## Activity Theory

A broad range in psychology (Hung, 1999; Leont'ev, 1978; Luria, 1979; Newman, Griffin, & Cole, 1989; Norman, 1991; Salomon, 1993; Scribner, 1984; Vygotsky, 1978) and anthropology (Chaiklin & Lave, 1993; Lave, 1988; Suchman, 1987) has shown that it is not possible to fully understand how people learn or work if the unit of study is the unaided individual with no access to other people or to artifacts for accomplishing the task at hand. Thus, the recent motivations underpinnings these studies is the study of activity or situations within context, understanding the relations among individuals, artifacts, and social groups.

Activity theory is a "philosophical and cross-disciplinary framework for studying different forms of human praxis as developmental processes, both individual and social levels inter-linked at the same time" (Kuutti, 1996, p. 25). In addition, activity theory can provide principles of developing an appropriate instructional framework, in the context of this paper, because it seeks to understand technological innovation as part of a general process of cultural evolution in which artifacts mediate human activity (Leont'ev, 1981).

Fundamentally, activity theory adopts Marx's dialectic materialist view of activity and consciousness as dynamically interrelated (Leont'ev, 1972), which provides an alternative perspective to the more common notions of mentalistic and idealist views of human knowledge— learning must precede activity in that mind and environment are dualistic. Traditional school practices are grounded on such a dualistic worldview.

On the contrary, activity theory posits that conscious learning emerges from activity or performance, not a precursor of it (Jonassen & Rohrer-Murphy, 1999). It focuses on the interaction of human activity and consciousness (the human mind as a whole) within its relevant environmental contexts, similar to the recent notions of situated cognition (Bredo, 1994). Activity cannot be understood or analyzed outside the context in which it occurs (Suchman, 1987). Activities are thus not static or rigid entities; they are under continuous change and development. An activity always contains various artifacts (e.g., instruments, signs, procedures, machines, methods, laws, forms of work organization) and these artifacts have a mediating role. For example, an instrument mediates between an actor and the object of doing; the object is seen and manipulated within the limitations set by the instrument or tool. In addition, artifacts are created and transformed during the development of activities themselves carrying within them a historical culture—a historical residue of that development.

Hence, the general philosophy of activity theory can be characterized as an attempt to integrate the objective, ecological, and sociocultural perspectives. Like Piaget's (1950) and Gibson's (1979) approaches, and unlike traditional cognitive psychology, activity theory analyzes human beings in their natural environment. Moreover, activity theory takes into account cultural factors and developmental aspects of human mental life (Bødker, 1991; Leont'ev, 1978, 1981).

The Basic Structure of an Activity

A team working together on an interdisciplinary project can be seen as a basic unit engaged in an activity. The team has objectives to be achieved with certain outcomes. Within the team, the members function as a community of learners operating under explicit and implicit rules of governance, division of labor, and mediated by tools (see Figure 1 below).
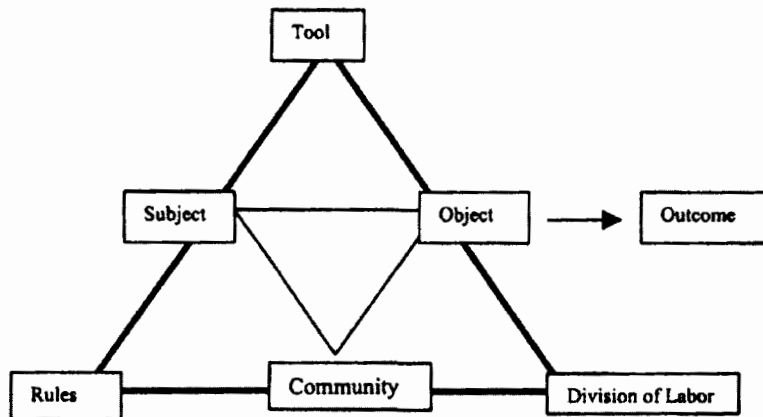
Figure 1. Structure of an activity (adapted from Cole and Engestrom, 1991)

From Figure 1, *tools* mediate between *subjects* and *objects* or objectives (see bold lines). Extending the notion of mediation, *rules* mediate between *subject* and *community*; and *division of labor* mediates between *object* and *community*. Rules form the basis for working between subjects in the community. Division of labor is the means through which members in the community work through the object to be achieved, which then results in an outcome.

An activity is a form of doing directed to an object, and activities are distinguished from each other according to their objects (i.e., intentional objectives and goals). Mediation is carried out by introducing intermediate processes which carry with it the history of the relationship. Thus the reciprocal relationship between the subject and the object of activity is mediated by a tool, into which the historical development of the relationship between subject and object thus far is condensed. The tool is at the same time both enabling and limiting: it empowers the subject in the transformation process with the historically collected experience and skill "crystalized" to it, but it also restricts the interaction to be from the perspective of that particular tool (Kuutti, 1996).

Basically a tool is anything used in the transformation process, including both material tools and tools for thinking. Rules consist of explicit and implicit norms, conventions, and social relations within a community. Division of labor refers to the explicit and implicit organization of a community as related to the transformation process of the object into outcomes. Each of the mediating functions is historically formed and open to further development. From the perspective of the activity theory framework, technology should be designed to consider the activity system where considerations are made relating to the community of practice as a situated context. It becomes evident that technology cannot be designed in isolation of considerations of the community, the rules, and the divisions of labor in which the technology will be placed.

Activity Theory from the Vygotskian Perspective

In the same vein as activity theory, Vygotsky (1978, 1981) together with Leont'ev (1981) posit that mind emerges through interactions with the environment. In particular, through a process of internalization of external activity, artifacts affect the kinds of mental processes that develop. Conversely, artifacts can also evolve and

change activity. Human learning proceeds from external action to internal activity. Children act in the world without understanding what they are doing; however, through the process of acting in the world, gradually they notice patterns in their behavior and come to understand their external activity. With this new understanding of their activity comes the internalization of that activity. Gradually children rely less on the external supports of people and objects in the world to cue their behavior as their behavior becomes directed by internal mental processes. However, because the process is one of internalization of external activity, a child's thought processes can go beyond those permitted by the external activity. Vygotsky argues that this development occurs through the child's active manipulating of the external world to support new ways of thinking.

Activity theorists also argue that human activity and the means that mediate it have arisen through social interaction. Given their belief that the same processes underlie both cultural and individual development, social interaction is also fundamental to Vygotsky's theory of child development. One of the ways children interact with the world they do not understand is by mimicking adult activity. Similarly, adults can provide a secondary means of mediation or a social scaffold (Bruner 1986, 1996) between the child and the world. In other words, with the aid of an adult, children are often able to perform tasks that as individuals they would be incapable of. Thus the child has two levels of performance: the level that he or she can achieve alone and the level that the child can achieve with the help of a more experienced individual. Vygotsky refers to this latter performance ability as the Zone of Proximal Development.

As thought is mediated by artifacts created and evolved within a culture or community, ways of thinking within the community is linked with the artifacts. One implication then is that children should be exposed to or actively engaged in the culture of which they are part, and to have access to, and participate in cultural activities mediated by artifacts similar to those of adults. Children cannot use the same artifacts as adults because they are at a different developmental level; however, artifacts modeled on adult artifacts and simplified in certain ways can mediate children's development of the skills (Bellamy, 1997). Besides using artifacts in their culture, adults actively change culture through the invention and development of new artifacts. Children can also be educated so that they can participate in this process, giving children the experience of evolving their own culture through their own designs. Such artifacts could be in the form of presentations, written documents, models, pictures, etc. The main essence is that children should be constructing their own artifacts and sharing with their community.

As thought is also mediated by social structures, conventions, and rules, children should be exposed to collaborative efforts with more experienced adults which can provide models of appropriate behavior and social scaffolding. This suggests that children can also be engaged in discussion and debate with a community consisting of experts and fellow learners. In such situations, experts, teachers, and students all learn from one another, although the student may be the most transformed. In a community people at all skill levels work together to achieve the community's shared goals. In such situations, beginners move from peripheral participation in an activity to central participation.

Three principles for the design of educational technology can be derived from Vygotsky's work:

1. Authentic activities: Students should have access to and participate in similar cultural activities to those of practitioners and adults, and use appropriate tools and artifacts modeled on those used by the community;
2. Construction: Students should be constructing artifacts and sharing their designs with the community;
3. Collaboration: Educational technology should provide opportunities for collaboration (discussions and debates) between experts and students and between peer learners.

## Computer-Supported Interdisciplinary Project Work (CS-IPW)

Interdisciplinary project work can be seen as a form of contextual activity-based learning and instructional process that places great emphasis on student problem solving as a collaborative effort carried out over historical period of time. Blumenfeld et al. (1991) described project based learning as centered on relatively long-term, problem-focused, meaningful units of instruction that integrate concepts from a number of disciplines or fields of study.

> Students pursue solutions to authentic problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, gathering information, collecting and analyzing data, drawing conclusions, and communicating their ideas and findings to others. (Krajcik, Blumenfeld, Marx, & Soloway, 1994, p. 483)

Hence in interdisciplinary project work, authentic work spanning concepts to be constructed from different disciplines is a key consideration. The projects should be engaged as a team effort where students work together with teachers who serve as coaches or facilitators to their work. In addition, experts in particular domains relevant to the projects can also be part of the team efforts whose main contribution would be in modeling behaviors and thought processes mediated by tools. Table 1 below reflects some principles in relation to Interdisciplinary Project Work.

Table 1. Principles of Interdisciplinary Project Work derived from Activity Theory

| *Collaboration* | *Construction* | *Authentic activities* |
|---|---|---|
| Students work together in small groups to solve an authentic problem | Students must construct knowledge and understanding based on their findings, including literature search and reviews. | Students engage in similar activities as experts in a community of practice. |
| Groups must collaborate in order to reach consensus of the findings and solution. | | Students investigate issues that are of real-world importance. |
| Experts are available to talk to students about their discoveries mediated by technologies such as emails. | Each student presents his or her findings to fellow learners through chat or forum facilities and presentations. | Students use real-world data to understand current events. |
| | | Students have access to arguments and opinions formulated by experts tapping on different intelligences that individuals may possess. |
| Teachers are coaches or facilitators to the group of students. | | |
| Teachers serve to evaluate students' work as feedback is necessary to progress. | | Students peer evaluate each other's work and are accountable to each other, demonstrating interpersonal intelligence. |
| Students gradually develop local expertise on the topic of study. | | Experts also evaluate the students' work and provide feedback to build on prior knowledge and extend knowledge. |

From the principles derived above, the structure of computer-mediated interdisciplinary project work activity can be perceived as in Figure 2 below.



**Mediating artifact**
(CS-IPW environment, pen and paper, diary, language, telephone, emails, spreedsheets, etc.)

**Subject** (Students)

**Object** (Constructing meanings of interdisciplinary concepts)

**Outcome** (A report describing results of findings)

**Rules** (Rules of competition, conduct, communication, etc.)

**Community** (teachers, experts, administrators, parents, fellow students, etc.)

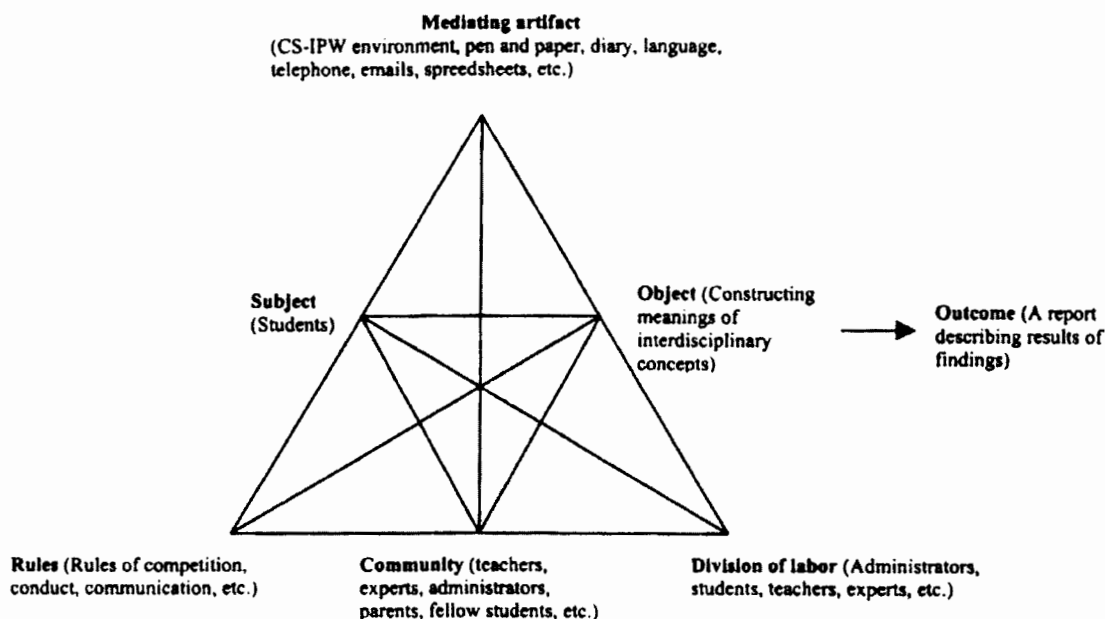**Division of labor** (Administrators, students, teachers, experts, etc.)

Figure 2. Application of Cole and Engestrom's analysis to CS-IPW

Fundamentally, the proposed CS-IPW system is an Internet based software application that integrates a number of tools designed to assist students involved in authentic investigations that closely parallel the work of real practitioners. As experts, students, teacher-facilitators, and administrators may be separated by distance, as in

real-life situations, the CS-IPW system is designed to facilitate such interactions. Students work on the projects with the object of constructing meanings and associations of interdisciplinary concepts with a distinctive outcome of a report (which could be a web-site) stipulating the results of their findings (see Figure 4). Students work toward the objects and outcome by constructing meanings through the use of mediating artifacts such as thinking tools, templates, schedulers, assessment rubrics, etc. Students also work collaboratively with experts, teacher-facilitators, and others in the course of their investigations through chat facilities, forums, etc.

Design of the CS-IPW Environment

In this section, we describe our current proposal of the design of the CS-IPW system which incorporates the fundamental principles of activity theory from Vygotskian perspective. Such a system would be piloted in two schools as an initial implementation.

From the pilot study, we hope to understand the viability and applicability of implementing CS-IPW. After the pilot study, we expect to embark on a larger scale research study with Singapore schools using the CS-IPW system. Figure 3 below describes a general overview of the CS-IPW environment.



Figure 3. General overview and registration process of CS-IPW

Under the *registration* for interdisciplinary projects (see Figure 3 above), schools consisting of different teams (no more than 4 students per team) can register for proposed projects identified by the system. These proposed projects are recommended by the SCTT CS-IPW working committee. Each of these projects are supervised by a SCTT-coordinator. Within each of these teams, one or two teacher-facilitators are assigned by the school and experts recommended by SCTT or the school will be made available for consultation with the teams. For the pilot study, a list of experts from NIE (National Institute of Education), SCTT (Singapore Center for Teaching Thinking), KRDL (Kent Ridge Digital Labs), and schools will be identified. Operationally, different teams from different schools will be competing with one another in solving the authentic interdisciplinary task.
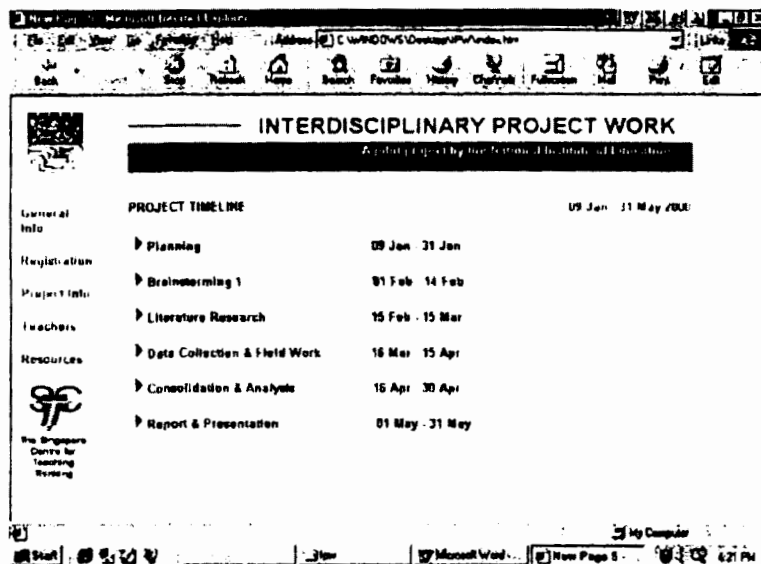


Figure 4. General timeframe as stipulated by SCTT

Under the *project info.* function of CS-IPW (see Figure 4), we have timelines stipulating the general time frame as required by the SCTT CS-IPW working committee. These include detailed breakdowns in terms of planning, literature research, data collection and fieldwork, consolidation and analysis, and report and presentation. Students can work within these general time frames and detail further milestones which they can follow.

Within the *project infor.* function, a scaffolding procedure is also provided where students are required to submit progress reports of their work in the form of charts and thinking logs—templates available for students to record their work. Logs on meetings with teacher-facilitators and experts are also available. See Figure 5 below.
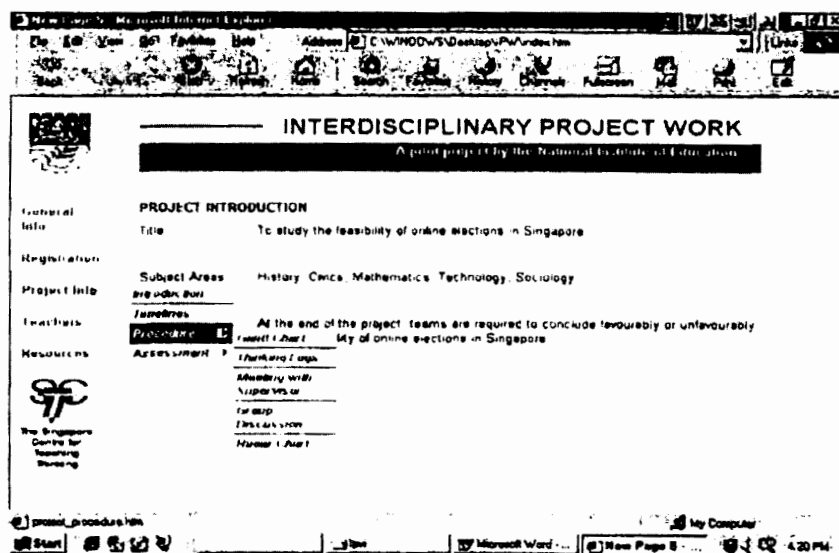


Figure 5. General scaffolding procedure

In terms of assessment (also within the *project info*. function), the CS-IPW SCTT working committee formalizes the overall scheme or percentage with the available matrix evaluation rubric. Peer evaluation templates, teacher-facilitator and expert evaluation templates are also available. See Figure 6 below.



Figure 6. Assessment within CS-IPW

Under the *resources* for project function, thinking tools which enable students to represent their knowledge constructions are made available. Social construction tools such as forum and IPW chat facilities enable students to discuss and debate on data and interpretations. These facilities also connect students with experts in the field. See Figure 7 below.



Figure 7. Resources available for students

The *resources* function also includes links to resources within the SCTT website and other important sites related to interdisciplinary project work.

## The Proposed Pilot Study

Based on the recommendations from the Singapore Center for Teaching Thinking, the pilot study of the CS-IPW system will be implemented in two Secondary schools in Singapore. The broad objective of the research is to conduct a process-oriented case study of how students engage in interdisciplinary project work through the CS-IPW system. More specifically, the study hopes to understand how students engage in thinking skills (through the SCTT recommended thinking templates) and meaning-construction of interdisciplinary concepts through a technology enriched environment. In addition, the study also intends to field its multiple assessment rubrics in order to determine the criteria and norms required for interdisciplinary project work. From the pilot study, we hope to derive hypotheses necessary to conduct a more empirically based research.

The methodology used for the pilot study is conceptualized from the principles of activity theory are as follows:

1.  A research time frame of six months, which we believe, is substantially long enough to understand students' activities needs to be developed; that is, the development and historical process where changes over time can be observed. Comparisons can be made between students' objects, goals, and actions in relation to others in the setting (or activity).
2.  Besides the detailed processes which need to be observed over time, attention will be accorded to broad patterns of activity, that is, the macro-picture of an activity. Such a macro-picture would give meaning to the narrow episodic fragments of an activity. These broad patterns provide the context for interpreting the microgenetic processes.
3.  The use of a varied set of data collection techniques including interviews, observations, video, and historical materials provide triangulation to interpretations made to any one of the techniques identified. For example, personal interviews of the students are needed to confirm one's conjectures of the motives underlining an activity or course of action. In this regard, interpretation of data must be from the students' point of view and not the observer-theoretician's perspective.

Generally, the pilot study is to be implemented and a competition system between teams across the two schools is to be organized. Students in each of the teams will develop web-sites on the findings. Presentations will be made to the SCTT and the best projects will be identified and prizes awarded.

## Conclusion

The above description of the CS-IPW is a tentative conceptualization with programming of the environment as depicted thus far. We have already conducted preliminary work on interdisciplinary project work (non computer-mediated) and find that this project is feasible and would be able to make an important contribution to education in Singapore.

## References

Bellamy, R. (1996). Designing educational Technology: Computer-mediated change. In In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction.* Cambridge, MA: MIT Press.

Bereiter, C. & Scardamalia, M. (1989). Intentional learning as a goal of instruction. In L. B. Resnick (Ed.), *Cognition and instruction: Issues and agendas.* Hillsdale, N.J. Lawrence Erlbaum Associates.

Blumenfeld, P.C., Soloway, E., Marx. R.W., Krajcik, J.S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist,* 26(3&4), 369-398.

Bødker, S. (1991). Activity theory as a challenge to systems design. In H. E. Nissen, H. K. Klein, & R. Hirschheim (Eds.), *Information systems research: Contemporary approaches and emerging traditions.* Amsterdam: Elsevier.

Bredo, E. (1994). Reconstructing educational psychology: Situated cognition and Deweyan pragmatism. *Educational Psychologist,* 29(1), 23-35.

Brown, J., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Bruner, J. (1986). *Actual minds, possible worlds.* Cambridge, MA: Harvard University Press.

Bruner, J. (1996). *The culture of education*. Cambridge, MA: Harvard University Press.

Chaiklin, S. & Lave, J. (Eds.) (1993/1996). *Understanding practice: Perspectives on activity and context*. Cambridge: Cambridge University Press.

Cole, M. & Engestrom, Y. (1991). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.). *Distributed cognitions: Psychological and educational considerations*. Cambridge: Cambridge University Press.

Collins, A. (1996). Design issues for learning environments. In S. Vosniadou, E. De Corte, R. Glaser, & H. Mandl (Eds.), *International perspectives on the design of technology supported learning environments* (pp. 327-362). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gibson, J.J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Hung, D. (1999, in press). Activity, apprenticeship, and epistemological appropriation: Implications from the writings of Michael Polanyi. *Educational Psychologist, 34*(3).

Jonassen, D. & Rohrer-Murphy, L. (1999). Activity theory as a framework for designing constructivist learning environments. *Educational Technology: Research & Development, 47*(1), 61-79.

Krajcik, J., Blumenfeld, P., Marx, R., & Soloway, E. (1995). A collaborative model for helping middle grade science teachers learn project-based instruction. *The Elementary School Journal, 94*(5), 483-497.

Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction*. Cambridge, MA: MIT Press.

Laffey, J., Tupper, T., Musser, D., Wedman, J. (1999). A computer-mediated support system for project-based learning. *Educational Technology: Research & Development, 46*(1), 73-86.

Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge, MA: Cambridge University Press.

Leont'ev, A. A. (1972). Sign and activity. In J.V. Wertsch (Ed.) *The concept of activity in Soviet psychology*. New York: M.E. Sharpe, Inc.

Leont'ev, A. A. (1978). *Activity, consciousness, and personality*. Englewood Cliffs, NJ: Prentice-Hall.

Leont'ev, A. A. (1981). The problem of activity in psychology. In J.V. Wertsch (Ed.). *The concept of activity in Soviet psychology*. Armonk, NY: M. E. Sharpe.

Luria, A. R. (1979). *The making of mind. A personal account of Soviet psychology*. Cambridge: MA: Harvard University Press.

Newman, D., Griffin, P. & Cole, M. (1989). *The construction zone: Working for cognitive change in schools*. Cambridge: Cambridge University Press.

Norman, D. (1991). Cognitive artifacts. In J. Carroll (Ed.). *Designing interaction: Psychology at the human computer interface*. New York: Cambridge University Press.

Piaget, J. (1950). *The psychology of intelligence*. London: Routledge.

Salomon, G. (1993). *Distributed cognitions: Psychological and educational considerations*. Cambridge: Cambridge University Press.

Scribner, S. (1984). Studying working intelligence. In B. Rogoff & J. Lave (Eds.) *Everyday cognition: Its development in social context*. Cambridge, MA: Harvard University Press.

Suchman, L. (1987). *Plans and situated actions*. Cambridge: Cambridge University Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*, Cambridge: Harvard University Press.

Vygotsky, L. S. (1981). The genesis of higher mental functions. In J.V. Wertsch (Ed.), *The concept of activity in Soviet psychology*. White Plains, New York: M. Sharpe.