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Published in:

Proceedings of the 34th Annual Hawaii International Conference on System Sciences

Published: 01/01/2001

Document Version:

Post-print, also known as Accepted Author Manuscript, Peer-reviewed or Author Final version

Publication record in CityU Scholars:

[Go to record](#)

Published version (DOI):

[10.1109/HICSS.2001.927166](https://doi.org/10.1109/HICSS.2001.927166)

Publication details:

Vogel, D., Davison, R., SHROFF, R., & Qureshi, S. (2001). Methodological issues in assessing sociocultural learning. In *Proceedings of the 34th Annual Hawaii International Conference on System Sciences* (pp. 1-10). IEEE. <https://doi.org/10.1109/HICSS.2001.927166>

Citing this paper

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Methodological Issues in Assessing Sociocultural Learning

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Abstract

While research findings regarding learning are somewhat mixed, early indications are encouraging and suggest sociocultural learning is useful in improving student learning under certain situations. It is suggested that future research efforts may be enhanced by more closely linking research to theory, building on the research from the field of education, and developing appropriate instruments to measure learning. This paper includes a summary of methodological issues as well as empirical findings. The purpose is to assess sociocultural learning from positivist and interpretivist perspectives and to identify issues that researchers may wish to address when designing future research projects. The research and theory presented in this paper serve as a catalyst for future exploration of electronic collaboration related to student learning and educational reform.

1. Introduction

In educational contexts, we seek to prepare students for present and future organizational demands. The characteristics of the new millennium suggest we give students the experience of working in multi-cultural distributed teams, notably those that cross disciplinary and national boundaries. In these learning environments, we are interested in how students from different cultures can work together effectively, not by establishing common ground or by adopting a particular culture, but by accommodating each other's culture in a synergistic fashion. We tend, however, not to assess systematically whether learning is occurring nor to question if value is added to the educational process that compensates for the extended efforts expended.

A number of approaches to the study of learning in collaborative contexts have been suggested [11]. Of these approaches, the sociocultural learning model has an especially good fit with attributes of multi-cultural distributed learning, since its tenets include the notion that knowledge cannot be dissociated from the historical and cultural background of the learner [15]. Therefore, it is important that students begin to construct meaning on their own terms and in their own interests within their own culture. Socioculturalists are especially concerned that different cultures should be respected and encouraged to co-exist in the context of shared activities, with no cultural hegemony being imposed.

Technology in general, and groupware in particular, provide a way to bridge physical distance without physically disrupting people and hence potentially enable synergy to emerge. A variety of collaborative technologies have been shown to enable such experiences in classroom settings [e.g. 2]. As we move beyond "here is what I did in my class" and explore the nature of sociocultural learning, a number of questions arise, including: Does sociocultural learning occur? What else occurs (or does not occur)? Can we tell over time whether learning is improving?

In this paper we examine methodological challenges in assessing sociocultural learning. For context, we use a recently completed distributed team project with students from two distinct cultures located on two continents. Positivist and interpretivist perspectives are addressed and conclusions are drawn.

2. Background

2.1 Sociocultural Learning

The sociocultural learning model provides a backdrop against which to create an environment and examine the implications of team interactions. The sociocultural

model, which is centered around the writings of Vygotsky [21,22], has been characterised [11] as “both an extension of and a reaction against some assumptions of constructivism”. As with constructivism, the sociocultural model recognizes knowledge as created (constructed) by each learner. However, rather than assuming, as does Piaget [17] that the goal of learning is the formation of abstract concepts to represent reality, socioculturalists feel that knowledge cannot be dissociated from the historical and cultural background of the learner [15].

Many other researchers and scholars have disseminated their own research findings and documented theoretical foundations, pedagogical developments and instructional approaches to sociocultural learning building upon the work of Vygotsky [21,22]. For example, Wertsch [23] argues that the means that we bring to bear in communicating and interpreting our experiences are necessarily culturally constituted. Reasoning is conceived to be an inherently social and cultural process of meaning making. Meaning making is not viewed as an isolated mental activity but as a joint product of the person and the mediating means, operating in a particular setting [15]. A set of constructs emerges upon examination of the sociocultural literature.

- *Mediation*: Social and individual psychological activity is influenced or mediated by the tools and signs in one’s sociocultural milieu (e.g., written language, maps, artwork, diagrams, computer screens, etc.) [24].
- *Zones of Proximal Development (ZPD)* refers to the distance between actual or independent problem solving and performance when provided with learning assistance from adults or more capable peers [25].
- *Internalization* is the process of taking new information that was experienced or learned within a social context and developing the necessary skills or intellectual functions to independently apply the new knowledge and strategies [19].
- *Cognitive Apprenticeship* refers to a socially interactive relationship and assumes that newcomer learners should be acculturated into an established community of practice by observing and participating on the periphery [16].
- *Assisted Learning*: Because learning precedes development, effective instruction can provoke developmental growth or rouse new skills to life. As a result of this malleability of intelligence to instruction, teachers are vital in creating learning environments rich in meaning making and social negotiation activities [20].
- *Teleapprenticeship*: As a result of advances in technology tools, there is a myriad of online learning environments that are mediated by experts, peers, mentors, teachers, and so on, to help learners and teachers

build and share knowledge through access to specialized expertise and information [18].

Scaffolded Learning relates to the various forms of support or assistance provided to a learner by an expert or more capable peer that enables the learner to complete a task or solve a problem that would not have been possible without such support.

Intersubjectivity refers to a temporary shared collective reality among individuals. Conferencing and collaborative technologies can foster such shared space or situational understanding between learning participants that can help them negotiate meaning, design new knowledge, and develop multiple problem-solving perspectives [12].

Activity Setting as Unit of Analysis: Sociocultural theorists argue that the proper unit of analysis for research should be the activity or word meaning. Specific circumstances of an event or activity are essential to understanding how people act in their attempt to reach their goals [25].

Distributed Intelligence in a Learning Community: Participation in a classroom is no longer didactic or transmissive, but a sophisticated instructional conversation. Though technology is vital here, so too are other resources; such as experts, peers, self-reflection, assessment and the funds of capital within one’s local community [3].

2.2 Technological Support

If, as Vygotsky [21] contended, student learning and development cannot be understood without reference to the social context, then it becomes essential to study the role of technology in a distributed environment. Such technology might offer new channels of communication and apprenticeship among students and learning participants of different cultural backgrounds, ability levels, and areas of expertise [10]. In fact, technology has been widely used to support a constructivist perspective of education [8], and the use of collaborative technology to assist learning in classroom contexts [e.g. 1] and to link classes together, whether within a country [e.g. 2] or between countries [e.g. 7] is increasingly common. A variety of technologies other than e-mail are available to support distributed teams, including videoconferencing and groupware.

Groupware has much to offer in the context of distributed team support. In general, Group Support Systems (GSS) seek to minimize process losses and maximize process gains. Potential process losses include travel time, language difficulties, air-time fragmentation, attention blocking, conformance pressure, free riding, information overload and incomplete task analysis. Process gains, on the other hand, may include more

complete information, synergy, more robust evaluation, stimulation, buy-in and cultural learning [14]. When teams are distributed, it becomes easier for individual cultures to remain intact and let technological support enable sharing and communicating. When properly configured in support of appropriate processes with minimal critical structure, collaborative technology can provide a degree of freedom in helping multi-cultural teams achieve synergy in being both effective and efficient. GSS, for example, are recognised as positively affecting knowledge acquisition [9] and have been suggested to help combat groupthink. There are, however, noted deficiencies. In general it is easy to support divergence but support for convergence is especially lacking. There is also a distinct lack of sense of presence in distributed settings, and frustrations with performance, reliability and integrating tools abound.

These issues may often be the result of different perceptions or world views of group members. This diversity is more prevalent in geographically distributed virtual teams as the greater cultural differences combined with varying abilities of expression in the virtual spaces contribute to the divergence in perceptions. Such diversity, analysed from a socio-cognitive conflict perspective, is seen to bring about learning. Doise and Mugny [4] define socio-cognitive conflict as: "... *not merely an opposition of responses [but] ... a conflict between social agents occupying social positions*". For socio-cognitive conflict to take place, a diversity of knowledge must exist and be socially represented, while there should be confrontation between socially represented cognitive differences. Groupware technology provides the virtual meeting space in which this diversity of knowledge may be communicated and resolved. Episodes of learning in virtual teams may be identified when the varying perceptions communicated in the virtual space are resolved and convergence is reached.

2.3 Research Setting

In the Spring of 2000, the opportunity arose to study sociocultural learning in the context of a distributed team project with students from two distinct cultures located on two continents. The Hong Kong participants were 21 part time students with full time jobs as middle managers. The Global Accounting Information Systems course was offered to students at the City University of Hong Kong pursuing a Master of Arts in International Accounting. The Hong Kong students were linked with 104 full time upper level undergraduate students in Information Management from Erasmus University in Rotterdam, the Netherlands. It is important to note that while English was the common language of communication, all students used English as a second or third language.

Each Hong Kong student was teamed with five Dutch students. Each of the 21 teams was given a task relating to the way in which teams function in a virtual organization drawn from a published list of important items related to managing IT in a global context. An online web-based groupware (eRoom) (<http://www.instinctive.com>) was utilized to support students in their tasks. eRoom allowed students to work together at any time and in any place (e.g. chatting and brainstorming in groups; making a group decision or voting; arranging and organizing meetings; keeping track and sharing a group's files). Each team had a private team room as well as the opportunity to visit common spaces (e.g., the information resource center) and the ability to drag and drop material from a private team room to a public display area.

The students needed to discuss the task using the eRoom software tools, adapting their use of the tool to incorporate any activities that they wished to perform, e.g. brainstorming, polling, consensus formation, etc. Each group needed to produce a set of critical success factors (CSFs) for the virtual organization for their particular task.

3. Methodological Challenges

Numerous methodological challenges arise as we seek to explore and better understand the nature of sociocultural learning and remove uncertainties.

3.1 Contrasting Approaches

One of the first issues confronting researchers in this area is the approach to be taken. Arguments can be made for both positivist and interpretivist perspectives with regard to facets of sociocultural learning. In the following paragraphs we have purposely amplified differences to assist in comparison and contrast.

Teambuilding is an integral aspect of sociocultural learning. From a positivist perspective we are interested in the effect of key variables such as anonymity, task focus, group size, cohesion and structure with and without technological/tool support. We are often looking for causal relations between variables. From an interpretivist perspective, we are more interested in descriptions of social norms, behaviours and roles that emerge through the use of the technology, as well as an interpretation of their relationships.

Mechanisms for managing interdependencies and integrating specialized parts become an issue in sociocultural learning as we deal with project complexities. A positivist often seeks optimization models of specialized modules simulated to illustrate possible coupling between the parts. An interpretivist, on the other hand, might focus on the characterization of different types of mediating activities that evolve through

the use of the technology.

Channels necessary to sustain coordination in distributed groups gain importance in trying to create an environment in which sociocultural learning can flourish. A positivist may focus on structured processes such as agenda setting, and time keeping, and specific tool support. Creation of a business process along with technological channels for coordination becomes an important activity. An interpretivist may describe interpersonal communication, and interaction that bring about the creation of social structures and organizational channels for coordination.

Support for knowledge work at different places and times is key to sociocultural learning. A positivist might focus on development of “tailorable” technological infrastructure with specific information provision tools such as intelligent agents. However, an interpretivist may well be more interested in sharing of skill and expertise and emergent work practices that occur as a result of ways in which these are supported by the technology.

Adapting technology to work practices while facilitating innovation and diffusion is an important element of sociocultural learning. A positivist may focus on development of flexible tools and help routines that enable users to appropriate the technology to their own ways of working and communicating electronically. An interpretivist may be more interested in insight into organizational learning through technological, work and social adaptation.

While both positivist and interpretivist approaches can be applied individually to sociocultural learning, the choice of research approach affects the type of knowledge gleaned and is thus a matter for careful consideration. Employing both approaches in parallel is desirable, as the complexities associated with distributed group support are considerable and complementary gains can be considerable, though the results from one may not always be useable in the other.

3.2 Levels of Analysis

Sociocultural learning can be studied at a variety of levels of analysis. There is an impact on the individual as s/he seeks to reconcile aspects of personal culture and familiar approaches to learning when confronted with “foreign” and unfamiliar approaches. However, the formation and adaptation/enrichment of individual mental models is a salient characteristic of sociocultural learning. On a group level of analysis, there are a variety of interaction dynamics that are especially interesting. Process gains and losses with multi-cultural teams may (or may not) align with those of more homogeneous groups previously studied [14]. At an organizational or institutional level, a number of special considerations and

implications arise in sociocultural learning. Among these are the prevalence and impact of corporate culture as well as the creation of environments that are conducive (or hostile) to sociocultural learning. Finally, at a societal level of analysis, we are interested not only in the impact of regional culture and behavioural norms but also in educational systems, regional history and interaction. For example, a history of war or peaceful co-existence between countries/regions can be expected to influence sociocultural learning.

3.3 Measurement

Measurement becomes an especially salient issue in investigating and assessing sociocultural learning. Numerous opportunities and sources of data exist. Observation plays an especially important role in developing an impression of individual excitement and frustration (and the changes therein over time) as well as interaction patterns between instructors and students. Questionnaires serve an important role in assessing constructs of sociocultural learning and enabling comparison across groups. Student reflections become an important element of the assessment process as they help explain a number of issues related to sociocultural learning. Using groupware to record interactions provides an important source of data for both process and content analysis. The evaluation of outcomes in terms of projects and other required results is an important source of information especially in the comparison of low performing and high performing groups. These evaluations may involve both peer and instructor appraisal. Prior experiences play an important role in group dynamics and need to be ascertained, while focus groups can be particularly valuable as they enable participants to focus on issues and develop consensus.

4. Experiences

In this section, we relate some of our accumulated experiences in assessing sociocultural learning.

4.1 Measuring Culture

If we view culture in a broad sense as patterned ways of thinking, feeling and reacting, it is clear that distributed teams may be influenced by a number of perspectives. At the same time, we recognize that aspects of national, professional, and corporate culture may emerge as teams interact to solve problems. In short, culture may affect the way teams and their members work. This will become an increasingly important issue as multi-cultural teams become more commonplace. We have tried to apply Hofstede’s [6] value survey but the results were so widely (and wildly) distributed within a supposed bounded single

culture that we concluded that the five dimensions were not useful for our research.

4.2 Translating and applying the learning model

To assist in measuring sociocultural learning, we developed a questionnaire (see Appendix) with 52 items that contributed to the 10 constructs previously noted. The instrument was administered to the students using a web-based GroupSystems survey. Content validity was addressed by drawing representative questions from a universal pool. Discriminant validity was addressed by examining how the items underlying each construct loaded on different factors. 115 of the 125 students responded to our questionnaire (92%). For the 41 items retained in the instrument, an item-respondent ratio of 1:2.8 was achieved. To test the construct validity of items in the instrument, confirmatory factor analysis was performed and reliability of constructs assessed using Cronbach's alpha. The reliability levels of the constructs vary from 0.45 to 0.80. All ten constructs that we proposed have been validated with factor analysis but, in some cases, individual items were thrown out as they did not have loadings above the 0.5 level that we employed.

Upon reflection, we suspect critical success factors are beginning to emerge based around the constructs in the sociocultural literature identified in our instrument. Specifically:

- *Mediation* seems to bring to the fore issues associated with learning transformation,
- *Zones of Proximal Development (ZPD)* provides indicators of communication effectiveness over distance,
- *Internalization* gives a sense of knowledge application,
- *Cognitive Apprenticeship* illustrates self-directed learning,
- *Assisted Learning* aligns with facilitation,
- *Teleapprenticeship* indicates technology supported learning environment effectiveness,
- *Scaffolded Learning* relates to the impact of external structuring,
- *Intersubjectivity* gives an indication of synergy among team members,
- *Activity Setting as Unit of Analysis* relates to activity setting comfort, and
- *Distributed Intelligence in a Learning Community* gives a sense of knowledge management.

As we have the opportunity to refine the instrument, it may be useful to move away from the language of the sociocultural literature toward terms more easily identified and along the lines of the emerging critical success factors.

4.3 Evaluating Group Interactions and Output

Field observations, student reflections and evaluation of output gave us a rich view in assessing sociocultural learning. The projects provided a high degree of realism and relevance that was genuinely appreciated based on our observations and student feedback. Students reacted positively to the use of technology and the opportunity to interact internationally. In course feedback, students noted that “activities which allow discussion at any time and place with members with different culture and thinking” were particularly effective. Hong Kong students rated this mostly highly out of nine course activities. However, differences in study background created confusion for the teams when attempting to achieve a shared agreement on issues relating to the research questions.

Learning occurred as students with various opinions were able to effectively communicate with each other, bringing about a diversity of knowledge. In these situations, students changed from being passive recipients of knowledge to active participants in their own learning. At the same time, the role(s) of the instructors changed to incorporate a strong element of learning and process facilitation.

Responses of the students from the six teams whose coursework was rated most highly (A or A+), and further broken down by country, provided findings that reflected back on the constructs measured in the questionnaire. For the Hong Kong team members, the responses tend to be positive, with minimal disagreement, though at times there are very high levels of "neutral" results. It is interesting to note, for example that the HK students had a markedly lower level of agreement (43%) with the suggestion that learning is more effective if done by oneself, rather than being shown what to do - compared with the responses as a whole (80%) and compared to their Dutch team members (85%). This is likely to be a product of the HK educational system, which has traditionally emphasized rote learning and memorization. Such ingrained values die hard and further underscore the importance of background in assessing sociocultural learning.

Teams with Hong Kong female members tended to outperform those with their male counterparts. In part, we attribute this to a more nurturing style of leadership. Instructors in both Hong Kong and the Netherlands observed that Chinese women have particular leadership skills that enable them to handle difficult unstructured problem situations. The Netherlands instructor felt that this combined well with the Dutch desires for structure and definition. In a separate study, Lind [13] noted that women in a virtual group setting were more satisfied than men and felt that group conflict was readily resolved. These observations underscore the conviction of Gefen

and Straub [5] that researchers should include gender along with other cultural effects.

4.4 Interpretations of Virtual Team Interaction

The virtual teams displayed a rich set of interactions that are worthy of consideration. In this section a selection of transcripts are interpreted using the issues raised previously.

Teambuilding in the virtual spaces was reflected in the social norms, behaviours and roles that emerged. A characteristic of the high performing teams was the high level of social interaction that took place in a social area set up for each team. In the high performing teams, members took the trouble to put up scanned photographs and get to know each other better.

Transcript 1: Getting Acquainted

Introduction K (HKNTH19, 13 Apr 2000 9:11pm): Hello everybody, I am Kees van Wensem, 22 years old, 1.77 m high, blond hair, blue eyes, bla, bla, etc.. As well as Erik, I am also doing the major Information Management. I think that this project will succeed, because I like the idea to discuss a topic with people from the other side of the world. Goodluck everybody, we will form an excellent team !!!

Intro RK (HKNTH19, 16 Apr 2000 8:19pm): Hello everybody, this is Robbert from Holland. I am following the same course as Erik and Kees. Hopefully we can realize a good interaction so this project wil have a good outcome. Well all the best to everybody! .

The leadership roles were very distinct in the behaviour of the HK female members. Group 1 had the benefit of this type of leadership. Transcript 2 illustrates the nature of this leadership role:

Transcript 2: HK Leadership

Mei (HKNTH1, 10 Apr 2000 2:35pm): Hey, let's begin our discussion. What do you think?

Discussion (HKNTH1, 10 Apr 2000 2:43pm): We just read our assignment and right now we're thinking about important issues concerning coordination and control for an IS. Do you have any ideas yet?

Mei-Discussion (HKNTH1, 10 Apr 2000 2:46pm): Could you pls add your points in the directory "How.....control"--> "Critical success Factors". I suggest all of us to add the points in the folder "Critical Success Factors" and at the end of the project, we will take vote to finalize the CSF for the questions. I am also thinking

directory? (HKNTH1, 10 Apr 2000 2:49pm) Where is the dir??

Mei (HKNTH1, 10 Apr 2000 2:54pm): That is the map on the left hand side of the screen layout. You should see the "critical success factors"

comment (HKNTH1, 10 Apr 2000 3:04pm) We've seen the folder, can you comment on our points.

The other leadership style that emerged but was less prevalent was a more group oriented one. This is a characteristic of the Dutch culture. This group leadership was most apparent in Group 12 where the Dutch students took the lead. This is illustrated in Transcript 3:

Transcript 3: Dutch Leadership Style

Critical success factors (HKNTH12, 10 Apr 2000 2:58pm): What can you comment on the critical success factors on the IS support non-routine and interpersonal communication among organizational units?

Critical Success Factors (HKNTH12, 10 Apr 2000 3:05pm): D, Next days, here in Rotterdam, we will investigate the basic requirements/critical success factors to use IS for 'non-routine and interpersonal communication among organizational units.' Could you also indicate what you think to be the minimum requirements for successfull use of IS for this type of communication/cooperation.

Best regards, A and P

Touch in 12 hrs later (HKNTH12, 10 Apr 2000 3:08pm): Okay. You give me your finding on tomorrow. Now is 9:00pm. in HK. I need to go home for dinner and sleep. I will get in touch with you 12 hours later in my office. Please put your comments in the appropriate topic buckets!! (W & M, Erasmus University)

Mechanisms for managing interdependencies and integrating specialized parts were illustrated through mediating activities that evolved through the use of the technology. The discussion area was most popular for exchanging views on the problem being addressed. Individual group members of the high performing teams chose to represent their views on line and discuss these further using the tools available. The Voting tools were used to resolve differences and arrive at convergence. These episodes of convergences are illustrated in the following transcripts.

Transcript 4: Divergence

Further ideas (HKNTH10, 10 Apr 2000 3:26pm): Thanks for your explanation. Is it answering our question - "What sort of IS provide the organizational units ---?" And I would like to add something like:

- email system within a multinational company (to facilitate communication all the time)
- share of common database (e.g. through Internet, I could assess the accounting database in our Taiwan subsidiary, we use same accounting software)

M

Technical aspects (HKNTH10, 11 Apr 2000 1:06pm) Dear M, The question is very broad. The aspects that you mentioned are all technical. Which requirements are nessarry to function the IS. I think it is a good idea to emphasize on technical requirements. Maar, 163698

Cultural aspects (HKNTH10, 11 Apr 2000 8:51pm) Most of the aspects are technical, but i think that the cultural aspect, the way we accept and work with IS, will

influence the decision for a certain type of IS also. St. 157369

Transcript 5: Convergence

Usability (HKNTH10, 14 Apr 2000 12:24pm): To elaborate on the comment made by Stefan, I would like to add that the Acceptation has to do with culture, as well as with the ease with which users can learn how to work with the system. Lots of companies have problems because systems are hard to understand for users. I therefore believe that ease of use is a very important CSF, C W

The leanness of the media did in fact enable convergence in the virtual teams as participants were forced to express themselves clearly. Any conflicting perceptions were resolved quickly as interactions were more task directed then they would otherwise have been. A related observation is that face to face interaction among the Dutch group members displayed more divergence.

One noteworthy example of interactions among the virtual teams related to the emergence of social structures and channels of coordination, and the on-line facilitation of distributed work processes. This involved the development of a social pattern of interaction combined with the use of an on-line voting tool. As is illustrated in transcript 6, a member of the group took on the role of summarising the discussion and directing the other group members to vote.

Transcript 6: On-Line Facilitation

Participation Barriers (W B) (HKNTH12, 13 Apr 2000 8:50pm): Through virtual communication social barriers are taken away and are a major contribution to the succes of non-routine and interpersonal communication.

Vote on various identified CSF (HKNTH12, 14 Apr 2000 1:44am): Based on the various CSF which we listed in thsi discussion and the CSF's mentioned in the table in the GDN article, I made the attached excel spreadsheet. In this spreadsheet, the factors are divided into: technological adaptation factors, work adaptation factors and social adaptation factors.

For each group I indicated my Top-5 factors. If we all add our priorities/voting, we may have a better basis to distinguish between good and non-CSF's. P.

Adapting the technology to personal work practices also took place as is illustrated in transcript 7:

Transcript 7: Adapting technology to work practices

We can use this tool when it fits; for myself that most times during the evening and I log off when people in Hong Hong are about to wake up (?), About sharing knowledge: the eRoom application we use in Rotterdam is freely available on the internet and you can open your own eRoom-type website at www.Blackboard.com On that site, I created my own website, which I intent to use for writing reports with people located in various places,

These episodes suggest that sociocultural learning did take place and gave rise to new forms of interaction on the virtual spaces. Aspects of sociocultural learning that could be deduced from an interpretive analysis of episodes of virtual team interaction are: 1) Communication effectiveness over distance was tempered by the extent to which the technology was adapted to existing work practices. 2) There was internalization of the knowledge being taught in the lectures through self-directed learning; this was particularly true of the Dutch group members. 3) A degree of external structuring was necessary to ensure productivity in the groups studied. 4) Synergy appeared to develop in some groups while not in others. 5) Learning communities did evolve and the high performing groups did display a greater degree of interaction, reflection and use of reference material.

5. Discussion, Future Directions and Conclusions

We remarked earlier that while both positivist and interpretivist approaches could be taken in a sociocultural learning experience, sociocultural learning itself is rooted in the cognitive psychology literature. This literature enables a set of constructs to be identified. Furthermore, an instrument can be developed out of these constructs, and can be applied so as to give us a snapshot measurement of the situation that we have created - a measurement that could be used to compare groups and contexts. Together with the critical success factors that may be extrapolated from the constructs, we can move towards an improved understanding of sociocultural learning and hence suggest the salient features of this learning environment. A weakness of this approach is precisely that it is dependent solely on a snapshot, and does not tell us much about group dynamics and the way in which thinking and learning evolve. Such critical success factors could, however, be corroborated and/or augmented by an interpretation of the sequences of interactions and experiences themselves.

Indeed, the experiential knowledge that can be generated is important since it may be applied to other *similar* circumstances. This context specific knowledge can be further refined to reveal aspects of the phenomenon that were not previously known to exist. For example, an emerging phenomenon in the virtual teams studied was the evolution of new modes of facilitation. These facilitation mechanisms could be further refined and/or investigated to reveal mechanisms of facilitation in virtual teams. Likewise, the leadership characteristics of 'female Hong Kong matched teams' can be interpreted based on data obtained through the instrument as well as on researcher observations and prior experiential knowledge of the specific skills found in different cultural groups.

Our combination of positivist and interpretivist approaches in this study has revealed a number of new research directions to explore. An issue that is clearly relevant to global, virtual teams will be the interactions of team members from different cultures, but we also suggest that the issue of gender be considered, given the fact that skills and character do vary by gender. A second aspect of interpersonal interaction is its on-going, dynamic nature: teams don't exist only in single snapshots, but over time. Longitudinal studies of such teams that focus on the evolving nature of their thinking and learning will be valuable to many fields, including knowledge management, organisational learning and virtual team support.

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Appendix A

1. Mediation

Item	Item Name & Question Number	Factor Loading (FL)
M1	1. eRoom enabled team members to effectively edit documents and different types of external files.	.651
M2	2. The drag and drop function of files (from the Windows Desktop into eRoom) was a valuable tool to use in this project.	.689
M3	3. Real-time messaging was an important function that effectively enhanced the exchange of ideas in the project.	.628
M4	4. The polling function effectively enabled team members to reach consensus.	.758
M5	5. Routing was an important function that strengthened the quality of the Critical Success Factors developed.	.485
	Eigenvalue / % of variance explained	2.10 / 42.0%
	Cronbach's Alpha	.65

2. Zone of Proximal Development (ZPD)

Item	Item Name & Number & Question Number	FL
Z1	6. We used our meetings almost exclusively to discuss the issues related to our projects or assignments.	Excluded
Z2	7. We spent a good portion of our meetings socializing.	.508
Z3	8. We often got involved in intensive discussions of the designated topic or issues.	.770
Z4	9. We managed to help each other in solving problems related to the project.	.789
Z5	10. The mix of IT-tools used during the project offered adequate means of communication.	Excluded
	Eigenvalue / % of variance explained	1.47 / 49.1%
	Cronbach's Alpha	.45

3. Internalization

Item	Item Name & Question Number	FL*
IN1	11. I was able to understand comments made by my team members.	.502
IN2	12. I believe problems are best solved by people working together to find the answers.	Excluded
IN3	13. Harmony and cooperation guided our behavior during the project.	.652
IN4	14. The needs of the group were put before the interests of individuals.	.764
IN5	15. The eRoom project helped me to effectively identify gaps in my understanding and adapt to changes in the environment.	.613
	Eigenvalue / % of variance explained	1.64 / 40.9%
	Cronbach's Alpha	.49

4. Cognitive Apprenticeship

Item	Item Name & Question Number	FL*
C1	16. I found using eRoom to be stimulating.	.821
C2	17. The balance of control over task components and processes ensured that students were increasingly responsible for their own communication and learning.	.684
C3	18. Team members were willing to take responsibility for their own learning and not rely on the instructor(s) for assistance.	Excluded
C4	19. I am always learning from the world around me.	Excluded
C5	20. Learning is more effective if we discover it for ourselves, rather than being shown what to do.	.597
	Eigenvalue / % of variance explained	1.50 / 50.0%
	Cronbach's Alpha	.50

5. Assisted Learning

Item	Item Name & Question Number	FL*
A1	21. Positive responses were given to our suggestions.	.574
A2	22. It is believed that everyone will perform well if given appropriate support.	Excluded
A3	23. Eroom improved the instructor's ability to communicate methods and techniques.	.734
A4	24. Effective classroom instruction helped us to develop our cognitive skills and see different aspects of an issue.	.800
A5	25. Classroom instruction helped us to effectively reflect upon our own learning experience	.825
	Eigenvalue / % of variance explained	2.18 / 54.7%
	Cronbach's Alpha	.72

6. Teleapprenticeship

Item	Item Name & Question Number	FL*
T1	26. The efficiency of my work on the project was improved because I was able to use eRoom.	.764
T2	27. ERoom increased the quality of my on the project?	.838
T3	28. Online discussion provided a better environment for open communication compared to face-to-face discussion.	.646
T4	29. Online discussion supported equal participation by all team members.	Excluded
T5	30. I recommend the use of eRoom for other distributed project teams?	.684
	Eigenvalue / % of variance explained	2.17 / 54.3%
	Cronbach's Alpha	.71

7. Scaffolded Learning

Item	Item Name & Question Number	FL*
S1	31. Effective classroom instruction helped me to see different aspects of an issue.	.758
S2	32. Effective classroom instruction contributed in improving group and social skills.	.714
S3	33. The structure provided in eRoom was adequate to facilitate an environment conducive to in-depth discussion.	.583
S4	34. The method of instruction helped facilitate effective interaction & meaningful discussion.	.812
S5	35. Instruction included effectively using team-building activities to encourage group cohesiveness (e.g. getting students to introduce themselves to each other, making photos available, etc.)	.764
	Eigenvalue / % of variance explained	2.67 / 53.3%
	Cronbach's Alpha	.77

8. Intersubjectivity

Item	Item Name & Question Number	FL*
IJ1	36. The overall learning atmosphere stimulated my creativity and interest in further investigation, research and creation.	.792
IJ2	37. Working together as a team and getting to know people from another culture helped me to build new knowledge.	.742
IJ3	38. Being able to interact, discuss and cooperate with my peers helped me to easily exchange ideas and consider alternative perspectives and viewpoints.	.495
IJ4	39. The electronic classroom challenged my creativity and contributed to my overall motivation?	.801
IJ5	40. The eRoom project helped me to utilize prior knowledge to understand new experiences and apply course experiences to build new knowledge.	.654
IJ6	41. The experience of applying technology in a collaborative environment enhanced my learning.	.715
	Eigenvalue / % of variance explained	3.00 / 50.1%
	Cronbach's Alpha	.80

9. Activity Setting

Item	Item Name & Question Number	FL*
AS1	42. The project was adequately structured for us to communicate effectively through eRoom.	.861
AS2	43. The project contributed to my knowledge of working in virtual teams.	Excluded
AS3	44. During the project I had the feeling I was part of a global team.	.780
AS4	45. The group activities were appropriate for remote collaboration in this project.	.846
AS5	46. I believe it is important to always look for new ways to improve my work.	Excluded
	Eigenvalue / % of variance explained	2.07 / 69.0%
	Cronbach's Alpha	.77

10. Distributed Intelligence

Item	Item Name & Question Number	FL*
D1	47. The eRoom project helped me to effectively utilize available learning resources and consider alternative solutions.	.780
D2	48. The eRoom project helped me to effectively express my views?	.692
D3	49. Overall, the team members performed well?	Excluded
D4	50. Team members were able to collaborate effectively using eRoom.	.707
D5	51. The group project contributed in enhancing my IT skills.	.696
D6	52. Team members were looked upon as sources of information and expertise.	Excluded
	Eigenvalue / % of variance explained	2.07 / 51.8%
	Cronbach's Alpha	.69