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ABSTRACT

Asynchronous computer mediated learning (CML) provides a mechanism for student interaction that is unique among educational delivery systems. Collaborative interactive learning can lead to deeper learning than is possible without interaction among learners and may enable groups of learners to become more knowledgeable than the teacher in narrow areas. This paper outlines principles and strategies for promoting student interaction and collaboration in CML settings. Assumptions of constructivist learning are outlined that related to cultural context, social constructivism, social needs, development of constructions (schema) in CML, authentic learning, scaffolding in the zone of proximal development, and teaching methods. Collaboration is defined, along with aspects of collaborative learning: communities of practice, functional skills, peer exchanges, and reciprocal teaching. Strategies to develop interaction include coaching (a subset of scaffolding), collaboration under teacher control, and consideration of alternative CML materials. Learner motivation in CML is addressed. Interactive teaching strategies are discussed, including use of artifacts, complex material, and scaffolding; peer teaching strategies; cognitive apprenticeships; and intergenerational communities of learners (links between earlier and later groups of learners). (SV)

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MEDIATED LEARNING\***

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## DEVELOPING INTERACTION IN COMPUTER MEDIATED LEARNING\*

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### INTRODUCTION

Asynchronous computer mediated learning (CML) provides a mechanism for interaction which is unique among educational delivery systems. Some argue that this makes no difference in student learning. Others believe that technology can improve learning. We take the latter course. In this paper we will look at constructivist learning in CML settings, collaborative learning, the development of interaction (psychological, motivational, and teaching practices), teaching using collaborative learning, and the development of intergenerational communities.

Networked learning is a shared interactive way of thinking according to Levin (1995). It promotes collaborative interactive learning which leads to deeper learning than is typically possible without interaction between learners. When groups of learners think together, following their own interests, they may become more knowledgeable than the teacher in narrow areas. Potentially, this is where interactive CML may lead us.

### CONSTRUCTIVIST LEARNING

**Content Is Embedded in Culture:** What we know is a function of the perceptions which are shared with us by members of our culture. We use what we learn in a social framework to interpret and make sense out of new material. We, as children, start to learn socially from our families and from our friends, and the way we interpret and what we know about the world is a function of this learning.

**Learning as Social Construction:** Constructivist learning is based on the premise that each learner constructs his/her own learning by interacting with information and the environment. Learners do this by relating new information to the information which they already possess. (For a glossary of knowledge construction see <http://www.cs.colorado.edu/~ostwald/glossaries/kc-glossary.html>). New information is either added to the knowledge structure (assimilated) or it is added and it changes the structure because it causes new insight or creates other relationships which were not identified before (accommodated). Learning is assumed to be an active/interactive process in which the learner does something meaningful with the information and thereby transforms it into personal knowledge.

**Learners Initiate Interaction:** Those who interact in a social constructivist setting have the possibility of learning. Learning is driven by the participant's social needs to interact. What the learners know influences strongly the ways in which they can and are willing to participate in a learning community. A learning community is assumed in a social-constructive environment. Participation in socio-cultural processes changes as the learners grow physically, affectively, and cognitively. Learners and their knowledge are transformed by social interaction.

**Development of Constructions (Schema) in CML:** Early constructions in CML may not accurately represent reality, particularly in settings where the information being transformed is not firmly grounded in previous learning and understanding. This incomplete initial transformation lends some understanding to the difficulty that beginners have in using information that is not learned in an initially experiential way. As learners transform the information and more and more information is assimilated, the constructions become more realistic, more differentiated, and more complex. Asynchronous CML interaction refines construction of new knowledge.

**Authentic Learning:** Environments which are real and have meaning to the potential learner promote learning (see <http://spiders.arizona.edu/salticidae/salticidae.html>). Authentic learning settings, in which the learner can see how the information to be learned will relate to something that is real to the learner, engage learners and promote a passion for problem solving. Learners can transfer knowledge and problem solving strategies within the domain of knowledge if the learning is interested based and authentic. Interactive problem solving is facilitated in CML.

**Scaffolding Defined:** Scaffolding in CML is an interactive process by which a learner is assisted by others (teachers or peers) to acquire knowledge or skill which cannot be acquired without assistance at that point in time and skill. Understanding is determined by the previous experiences of the learner, past knowledge and the ways in which previous information has been stored (memory structures determine how new information will be assimilated or accommodated). Learners seldom come to a learning setting with the same background knowledge and discourse history. Differences can be scaffolded in CML hypertext. Even if learners have the same background knowledge they are likely, because of other factors such as, interest, intelligence, etc., to move through the material at different

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\*An expanded copy of this paper and its presentation are available at <http://home.okstate.edu/conference>.

rates of speed. This can be accommodated by CML tracking. Tracking can be seen as a form of pedagogical scaffolding. Through the collaborative process of scaffolding the true intersubjectivity of learning is developed where all parties share understanding of the task and work together to co-construct meaning and understanding.

**Mutual Articulation of Meaning:** Teachers and collaborative peers interact to weave complex information into new knowledge with (not for) the learner. This process is one of mutual articulation of meaning. Most information with which learners come in contact with has been created by others; little is discovered knowledge. Because information is created by others, it is shared in a social sense either by interaction between people or by their surrogates, e.g., books. As learners interact they transform this information into knowledge through interaction.

**Scaffolding in the Zone of Proximal Development:** Only some learners are ready to learn individually or with support at any given level. These learners are in the zone of proximal development, according to Vygotsky (1978). To be able to learn from particular information, a learner must have sufficient background knowledge to be able (with help) to start to process the new information into personal knowledge (see <http://edweb.sdsu.edu/people/bdodge/scaffolding.html>). Scaffolding can be provided at a variety of levels, depending on how close the learner is to being able to function independently. If the learner knows only a little, the scaffolder may need to model the complete act including describing personal thinking as the process unfolds. At a somewhat higher level of learner understanding, the scaffolder can have the learner model the process with assistance. Here the learner tries to perform and receives prompts or hints from the coach as the process unfolds. At a third level the scaffolder only has to identify the components which the learner should work with to start the process which the learner can then accomplish with little external assistance. At the final level the scaffolder only has to name the technique which should be used for the task to be accomplished. This last step is analogous to problem finding, or conditional knowledge, in the sense that the learner knows how to apply the knowledge but is unsure of when to use it or its appropriateness to a particular problem.

**Principles of Constructivist Teaching:** Start by focusing on local (learner) issues. Seek out learner questions and ideas as the basis for learning tasks, objectives, and goals. Follow the learner's interests. Encouraging learner initiation of ideas gets them involved, interested, and makes them owners of the process. Seek out real problems to work on-ones in which interest the learners. Learners should be encouraged to use alternative sources of information to insure that the outcomes are not biased and represent only a single perspective. Let the learners initiate the search for information (the Internet may be a good source). Make learning a collaborative process by having the learners discuss the information with each other as they transform information into knowledge. Learners should be encouraged to challenge alternative conceptualizations and ideas. This use of multiple perspectives in information discussion leads to deeper understanding and potentially to, understanding the assumptions one makes in learning, thus transforming learning. Learners should make predictions of the outcomes of solutions will be and then validate these predictions through the collection of evidence. When there are alternative perspectives, the learners should debate the choices and evaluate the final selection. Learners should reflect on possible solutions for problems, considering the risks, consequences, and effects of the solutions after decisions have been made. This is done through a process of self-analysis and reflection. Teachers should not try to have participants transfer the knowledge to other tasks and settings without guided application and facilitation so that the learners come to associate the new task or setting with the old knowledge.

#### **COLLABORATIVE LEARNING**

**Collaboration Defined:** Collaboration involves the development of communities, where groups or pairs of learners interact to learn and solve authentic problems. Collaboration fosters constructive learning. Collaborators can include learners, teachers, mentors, and researchers or others with whom a learner can develop a reciprocal interactive relationship. Interaction with peers and teachers supports question refinement and reflection, promotes a shared discourse, and establishes a learner culture which fosters cooperation and mutual interdependence. That is, the learning process becomes more like the real world in a professional sense. Common understandings result from social negotiation in collaboration. For a program on collaboration see <http://www.ascusc.org/jcmc/vol2/issue3/>.

**Communities of Practice:** One of the purposes of collaborative CML is to create communities of practice. A community of practice is a group which works together and shares beliefs, values and goals. As learners are integrated into the group they establish through practice a shared identity with other group members. We start with a group which shares similar goals and interests (this cannot be externally imposed). Members of the group determine the goals of the group on a particular project or activity. Then they work with others toward the common goal. This is the basis for the guild hall and the apprenticeship learning process and is the foundation for

collaborative learning. In collaborative CML there are no lurkers or free riders. One of the first things a group must do is to develop a commonly accepted knowledge base. This is usually developed by discussion of ideas related to the goals of the group. There is a socialization process which groups go through in the development of ritual communication, which is necessary for the development of collaborative communities. Community members use common tools and practices which are mutually agreed upon, and they learn as they are doing. Learners use reciprocal teaching, employ flexible turn taking, and distribute tasks to individuals as well as doing group work. This mutual regulation leads to the development of metaknowledge about the community. Collaborative decision making and strategic decisions raise arguments and requests for explanation. As communities develop their product or solution, they reflect on what they create and try to make it better. This reflection, which comes about as part of participation, is generated because each member must think about what others have proposed as well as that which they have created themselves. To integrate new members into communities of practice, teachers will help by helping them learn the common language of the discipline and by securing new learners invitations to the existing group. Learners emulate behavioral models where the beginners model the practices of the more skilled and the young model the practice of those who are older. The best of the same age or cohort are the eventual models. In this way information is transformed into knowledge and the social fabric of the culture is passed from one generation of learners to the next.

**Functional Skills in Collaborative Learning:** Learners should be taught the following functional skills in the collaborative process. Take turns, particularly if operating in a synchronous environment. Contribute your ideas, share what you know with others. Support your points with evidence, new information must be believable to others. Ask for help when you need it. Encourage others to contribute, this promotes the interaction of diverse opinions and improves collective thinking. Complement others' contributions. This will increase the frequency with which they respond. Check for understanding, both yours when new information is presented to you, and that of others, when you present information to them. Keep group members focused on the task. This will help you accomplish the task and will make the outcomes more meaningful and cohesive to all.

**Peer Exchanges:** In collaborative learning, interaction with peers provides motivation (others have the same problems that you do), support (many will try to help you when you get stuck), help (peers, once they are into collaboration, realize that helping others is a benefit for them. In addition it may be reciprocated. Groups have a collective intelligence that is lowered if some members do not understand and participate), encouragement [everything from verbal high fives when a breakthrough is made to smiles shown as :-)], assistance (many activities need two or more players to accomplish them; collaborators provide themselves), exchanges of information (we all learn as we share), and finally, challenging facts and assumptions (we all get it wrong or misunderstand it sometimes). Groups will confront ineffective strategies and misconceptions. This helps learners to clarify their thinking and produces a better understanding of the information in the long run. By collaborating we learn cooperative work skills and learn the give and take of interaction. This is necessary for many who have a public school background because these skills are seldom used in traditional classrooms. Collaboration builds on the strengths of each learner as those who are good at certain topics will do the majority of the leading in these areas. Other learners will move to the fore as their strengths are needed. Collaboration allows us to play multiple roles in learning.

**Reciprocal Teaching:** Reciprocal teaching in CML is one of the major processes in collaboration. Learners share meanings, they share necessary information which is transformed into knowledge, and they share conceptualizations and conclusions. All learners know the problem that they are trying to solve and each learner helps other learners by teaching what he/she knows. There is a shared problem context where they provide each other reciprocal scaffolding as all take turns teaching the group. In some cases this may be as simple as reading something (possibly from a reading list) that others have not read. The reader can lead the discussion on the new information and teach his/her peers. In this way learners are both producers and critics of the work in progress and they learn self monitoring in the process. Reciprocal teaching is a process of social interaction which promotes knowledge development and knowledge is a socially developed product. In the reciprocal teaching process the teacher should stress the idea of interdependence. Mediated discussions, like those in reciprocal teaching are realistic, relevant, credible, and technically stimulating.

#### **DEVELOPING INTERACTION**

**Coaching in Collaborative CML:** Coaching in CML, a subset of scaffolding, is a process of providing hints, cues, and feedback. It can be accomplished by peers or teachers. The coach observes the learner and provides scaffolding when it is needed. Not too much coaching should be given. If a coach is providing most of the activity the learner may not be at the appropriate development level in terms of this particular content. Coaching can be

used to provide, or remind about the use of a strategy or technique, as well as the direct teaching or modeling of the technique by the coach. When coaching is done the learner should retain control of the activity as it is assumed that the learner will maintain responsibility for the learning.

**Collaboration under Control:** Collaboration is not always done in a learner centered environment. In some cases the teacher retains control (see for example practices describe at <http://www.nki.no/~morten/>). When this is the case, there are a number of appropriate strategies Teams should be heterogeneous in terms of ability. Women and minorities should not be outnumbered by white males as this will suppress their interaction. There are a variety of exercises in collaboration such as jigsaw (each team member has part of the information and teaches it to the others), think-pair-share (pairs of learners first read information and then discuss it or one teaches the other), reciprocally guided peer questioning (where peers question each other in turn about information which all have read), TAPPS (think-aloud-pair-sharing-problem-solving), among others (see descriptions at <http://mwus.mokwon.ac.kr/~mis/research/download/coop2.html> ). Teacher control in collaboration is beneficial as it reduces learner cognitive management skills/needs. The teacher performs the goal setting, strategic planning, monitoring, evaluation and revising which learners would have to do if they were in charge of the process. On the other hand teacher control reduces learner confidence, sense making, and constrains the learning experience within teacher set parameters.(For a project design example see <http://www.gsh.org/wce/kerns1.htm>)

**Interaction with Different Materials:** Interaction in a CML environment is usually thought of as relating the interaction of people (see <http://scribe.iat.unc.edu/Courses/English12-70/e12-700.nsf?OpenDatabase>). However, much interaction takes place between learners and various types of materials. The accomplished teacher will lead the learner to material which is appropriate in terms of level and approach, but individuals will still have preferences as to the kinds of material with which they prefer to interact. Good teachers, who are trying to support individual differences in their learners, will provide alternative kinds of materials for learners to choose among. In CML these can include text on screen, books, articles, primary source material, simulations, streaming audio presentations, streaming video presentations, etc. Learners should be able to choose among alternative materials based on their learning preferences.

**Interactivity Is High Maintenance:** To maintain an interactive relationship with one or more team members takes a lot of effort. It is also exciting and challenging for most learners. Learners must recognize that they will have to spent more time than is usual for a course using interactive processes, if social construction is to take place effectively.

#### **PSYCHOLOGICAL FACTORS RELATED INTERACTION AND MOTIVATION IN COMPUTER MEDIATED LEARNING** (see <http://192.108.114.10/~mboudour/mab/csi.html>)

**Electronic Masks:** Some CML cyberspaces offer electronic masks, i.e., you can pretend to be someone that you are not. You can mask physical, cultural, racial, age and other factors. " All are equal on the Internet," as it says in the MCI commercial. Shy learners like CML. They are typically low in self confidence and low in social skills. The electronic masking effect allows some, but not all, of these learners to bloom and expand their personas. Shy learners do not respond well to flaming. They will either withdraw or they, because they feel protected by the medium, respond violently. Hiding and lurking are particularly likely when the rules of the space are not user friendly or for new learners when they are unsure of the appropriate rules.

**Learner Motivation in CML:** Generally, learners are more motivated to use CML than they are to come to a traditional class. Primarily this is because so many of them have had poor affective experiences in traditional classrooms. It is good to remember (Raffini, 1996) that some researchers believe that conventional instruction, by its nature, creates educational disability and undermines intelligence. Much traditional instruction controls student behavior by negative affect; shame, guilt, negative reinforcement, etc., for lack of conformity to teacher desire. Computers seldom laugh at you, humiliate you, or make you look stupid in front of your peers. They can severely frustrate you, but this almost always happens individually rather than in front of a group. Therefore, learners are likely to be more motivated when they come to you for CML. Typically learner motivation is likely to be intrinsic rather than extrinsic. Usually learners have a choice as to whether or not they will take a course which is computer mediated, although this may change rapidly in the future. Because of the constructive and collaborative nature of CML, learners are more likely to have control of the learning goals and therefore can shape them to come closer to their individual learning goals. Learner control increases the relevance of the learning and in turn improves learner motivation. There is a reduction in external control, and there is usually no direct supervision in asynchronous environments. Hence the learner must take more responsibility, and with responsibility comes motivation. Some learners need assistance in terms of learning how to pace themselves when they take responsibility for their own

learning. Some learners will go too slow (these are the ones most teachers worry about), but there are some that will go too fast or too deep (these are the ones we should really worry about). Some will disappear into the computer and only come up for air occasionally. There is such a thing as being too involved, and though this shows a high level of motivation, it may not be psychologically good for the learner, and it may affect their performance in other non-CML courses.

### **INTERACTIVE TEACHING PRACTICES**

**Teaching to Promote Interaction:** There are many principles of instruction that will support constructivist teaching or facilitation (see <http://www.mindspring.com/~profjer/article/role.htm>). Learners' knowledge is extended or deepened by repeatedly coming into contact with information or experience which builds upon what is already known. Learners take something new away from each of these information/experience contacts, transforms it, and adds it to what is already known, thereby increasing personal knowledge (see <http://www.geom.umn.edu/apps/>). This idea has led to a curricular organization called the spiral curriculum where the learner is re-presented information or is brought into contact with information a number of times in the course of a period of learning. Multiple contacts with ever more complex materials are designed into the curricular offering (see <http://ciue.rpi.edu/studio.htm>).

**Artifacts Shape Mental Processes:** Anything physical of tangible, which is not alive can be called an artifact. The objects in our environment and our knowledge of them determine the way in which we perceive our environment (see for example <http://www.duq.edu/PT/RA/RA.html>). If a learner has only a few learning tools these are the tools which will be used. If all we have is a hammer the world will be perceived as being full of nails. Our understanding of the artifacts also shapes the way we can use and interact with them (see a description of artifacts in science at <http://www.utexas.edu/depts/tnhc/.www/crayfish/astacidea/astacidea.html>).

**Stimulate with Complex Material:** There is a line of argument which favors the presentation of complex material to provoke learner interest, challenge, and interaction. Cognitive flexibility theory (Johansson and Spiro, 1992) asserts that teachers should teach using cases and rich examples. Teaching using cases makes the learning more authentic and practical. Edelson, et al. (1995) present methods for scaffolding using multiple case studies in a CML environment. The learners see the case as representing a real world situation and they find the setting for problem solving to be authentic. When new CML information is introduced, links can be made from the case examples to abstract concepts so that the information can be concretized and presented in a way that the learners can use to tie the new and abstract learnings to their previous knowledge. (See <http://curry.edschool.Virginia.EDU/go/capetown/intro.html>).

**Importance of Scaffolding in CML:** In CML scaffolding is more important than it is in traditional education because learning is typically collaborative. In this many-to-many learning, all participants will provide scaffolding to other participants at different times during the learning process. Because of this process, participants must be exposed to the idea of scaffolding and know when it is appropriate in the dialogic process. Those who need scaffolding may or may not know that it is needed. If they know it is needed, that is they cannot do what ever it is that they are supposed to do with out assistance then they should ask for scaffolding. Collaborative groups need to become familiar with when scaffolding is needed, how to ask for it, and how to give it in acceptable forms. In a psychologically safe environment, the teacher may be the first resource used for scaffolding until learners seek help from others. After collaborative groups have been working together for a while, there will be little need for external scaffolding from the teacher unless they cannot scaffold each other and their own internal resources have been exhausted. If teachers do too much scaffolding, much of the value of the collaborative experience designed to help them work together solving authentic problems will be lost.

### **PEER STRATEGIES**

**Peers Extend Ability:** The presence of colleagues who we can observe or interact with extends one's own abilities, according to Vygotsky (1978). We monitor our progress by observing what others do or are capable of doing. This validates what we do, provides a perspective on progress, and provides scaffolding, if we are not as far along as some of our peers. Having colleagues also helps us to articulate prior knowledge through the sharing process as we discuss what we know. In collaboration, we talk about what we know and elaborate on what we learn. This Vygotskian process, internalization, requires active participation on both sides. The learner who does not have the knowledge must be in the zone of proximal development. The advanced learner must justify the actions so that the learner can understand how to learn and why to learn. The learning is transformative and changes the knowledge structure of the learner. That is, there is a restructuring of the learner's knowledge. In fact, because of changes that happen as part of the explanatory process, there may be changes in knowledge structures on both sides.

**CML Activities That Invite Belonging:** Being part of a community invites belonging. This means that the learner must identify with the community and support its goals. Being part of a CML team invites belonging as does collaborative/cooperative learning which is focused on learner centered projects. When CML teams are developed, activities that invite belonging include email welcomes, asking of questions, invitations and sharing experiences. This can be done in a variety of settings including chat rooms, a course cafe, or a mutually used virtual space. As projects develop, putting everyone's name on the project invites belonging and responsibility. Motivators like "we can do it" or "you did a good job" are invitations to belonging. Belonging and interactivity can be promoted by asking for help from someone who is shy, asking for explanations from those who are reluctant to participate or who seems slow to catch on (for an example from project learning see <http://www.covis.nwu.edu/Papers/edmedia94.html>).

**COGNITIVE APPRENTICESHIPS** (see <http://www.ilt.columbia.edu/ilt/papers/JohnBrown.html>)

**Apprenticeships:** Apprentices are those who watch, follow, shadowed the beginning work in the learning of a skilled process which is usually Jourdan (1987) describes the traditional apprenticeship as being focused on doing rather than on talking or knowing. Work is the driving force. It has immediate value in that work is accomplished and through work of ever increasing complexity, there is progressive task mastery. The learner starts by performing easily learned skills, where mistakes are not too costly and learns to create a skilled performance. Performance standards are embedded in the work. The apprentice owns the problem for the piece of work with which he/she is involved. Expert task execution is obvious and expected as an outcome as the product will be used. Teachers and teaching may be invisible as the learners observe and do.

**Sequence:** Collins, Brown, and Newman (1989) describe the sequence in which information is transformed into knowledge and in which skills are learned in the apprenticeship moving from simple to complex. The learner starts by doing some basic practice which can be learned and practiced without too much supervision. The learner practices this skill until competent and is directed to move on to a slightly more complex skill. The learner is embedded in a cognitive community where he/she can observe others who are farther into the process performing at higher levels. This observation sets the stage for the learner's own future performance. As the complexity of the material increases, the diversity of the problem-solving also increases. The learner has to know not only how to perform the skill, but when the skill should be applied. This complexity sequence continues until the learner is ready to function without supervision and the learner is initiated into the expert community of practice.

**Method:** A variety of methods are used in the acquisition of skill and knowledge in the cognitive apprenticeship, according to Collins, Brown, and Newman (1989). The teacher can act as a coach offering hints, provide feedback, give reminders of when and how to do something, provide scaffolding when needed, and fade the scaffolding when the learner can perform independently. The learner can observe and try to replicate a demonstration by the mentor, engage in discovery processes, and invent procedures which become exportable strategies (a discussion is provided at <http://www.ilt.columbia.edu/k12/livetext/docs/berry1.html>).

**Content:** All learning is situated and is progressively developed through content related activity. The apprentice, according to Collins, Brown and Newman (1989), ignores the distinction between the vocational and the academic and learns what is necessary to do the job. Content may include learning how to know, cognitive management strategies, problem solving strategies or tricks of the trade and, of course, the information needed to perform the tasks. All of this can be provided in CML.

## **INTERGENERATIONAL COMMUNITIES**

**Defining Intergenerational Communities of Learners:** The basic idea for intergenerational communities come from James (1997) (see <http://www.soc.hawaii.edu/~leonj/leonj/leonpsy/gc/generations.html>) who presents the concept that learners from one class can create materials with which learners from later classes can learn (see <http://www.soc.hawaii.edu/~leonj/leonj/leonpsy/cognitive.html>). In other words, a class can create a database that others can mine. They can also create teaching materials that others can use so that learning will be easier. Learner created examples usually will be more on the level of new learners than teacher examples. If information for a class is collected and maintained in an electronic archive, each successive class or generation can use that material and build upon it. Hence, after several generations, learners should be able to go farther into the material and learn more than they would be able to if they had to start from scratch.

**Making Disciplinary Knowledge, Practice, and Culture Visible in Generational Curricula:** With the acquisition of the language or vocabulary needed to talk about information in a discipline, ideas are linked together creating a web of relationships which fosters understanding (see for example <http://www.soc.hawaii.edu/~leonj/leonj/leonpsy/instructor/kcc/kcc97.html>). For each new learner, alternatives are compared and new information is generated by integrating the existing information with new information. Learners critique ideas with guidance and



support from others and eventually develop their own ideas independently. Learners reflect on their progress and on the new structures which they have created.

**Benefits of Intergenerational Learning:** The intergenerational learning process maintains a focus on learning to acquire knowledge as opposed to information. Learners learn a variety of skills as the multigenerational database is constructed. They learn scientific and scholarly skills such as writing for the public, analyzing the work of others, expressing an intellectual position, and developing model school activities. Learners develop information literacy in a discipline and become familiar with technology as a medium of instruction. They also develop leadership and citizenship skills as they volunteer for projects (all activity should be voluntary and interest based). Each learner can expand the knowledge base and introduce innovations in teaching and learning, and maintain an intellectual presence in the community. There are a variety of positives which develop out of intergenerational practices. James (1997) lists several. Learners learn to reflect on practices of previous generations. They learn to develop individual meaning, and, by using materials previously created, they see evidence which helps in meaning development. They see variations in interpretation and meaning which deepens their thinking skills and provides scaffolding when they are learning. They act on the world and construct materials which again aid in the development of personal knowledge and in the provision of information for others in later generations.

**Developing Intergenerational Communities:** Students use materials developed by earlier generations to foster their own learning. This process leads to the development of multigenerational communities. There are a variety of forces that are at play here that develop when learners learn in this way (see <http://www.ls.sesp.nwu.edu/lc/Sitetoc.html>).

**Interactivity:** Interactivity strategies revolve around the process of interaction necessary to create collaborative documents within and across generations. Individuals create journals of what they do and experience, add this information to the database, and share it with others. Interview data with subjects or authors would be useful in certain disciplines. Notes which are shared with collaborators or are archived, provide source documents for future developers. Cognitive maps, which show structural relationships, are used to show structure and interrelationships between ideas and pieces of information. These maps may be used to scaffold, provide the basis for new relationships, or as source documents for further development. The use of interactivity in an asynchronous sense requires objective self-focus, particularly if the interactivity is cross generational.

**Generational Strategies:** Generationally, we have learners who will form teams within their generation to develop service modules which later generations will use. The team focuses on writing for each other (within generation) and for others across generations rather than for the instructor. This provides an authentic audience. Learners organize past work in new formats, feature past work in their work, and use past work as the basis for further expansions of ideas. They will develop coaching strategies for their peers and, after they are validated, leave these electronic coaches for others in following generations to use as scaffolding when needed. Other things that they might do include indexing and annotating prior reports, creating and developing new associations between prior knowledge, and creating cognitive maps which integrate old and new materials.

**Assignments in Generational Curricula:** James (1997) (see <http://www.soc.hawaii.edu/~leonj/leonj/leonpsy/gc/intro.html>) describes a process for making assignments in generational curricula. Learners write weekly assignments. From the assignments reports about the material they are learning are created. The learner reports are published on learner generational web sites which are linked to the general data base. Assignments are generationally cumulative and draw upon the work of earlier generations. Learners are told to write only what they believe in and understand; therefore, there are few problems with data which are incorrect. Learners develop collaborative projects, but each learner creates an individual report posted to the database. The reports developed are for the next generation of learners not for the instructor (authentic audience). Learners show pride in their work and try to attract others to use it. Both individual and team reports in the archive can be added to at any time to maintain currency and to improve their content. Learners make suggestions for future learners as to further explorations or ways in which the accumulating data can be examined (see for example <http://www.uvm.edu/~jphclass/bot160/>). Successive generations of learners maintain the archive. They read the material, use it, and link pieces of it to their reports to form a super document.

**Super Documents (Living Document Systems):** Super documents are compilations of smaller documents put together to store information and use it within the document in a variety of ways (see for example <http://www.psyc.nott.ac.uk/aigr/papers/Living-Documents/paper.html>). Components of the document are adaptive in the sense that they are used, integrated, cited and linked to other internal documents to serve new needs and to show the present status of information. The contextual set of information is expected to grow over time. If growth were the only factor, then the document would be nothing more than a file cabinet. However, besides growth the document evolves, changing to meet new environmental needs and to provide information to new participants. Information changes and the uses of the information too may change, also. Many types of information can be integrated into the document. Hyperlinking allows multiple orderings based on use and the needs of the users. Material is easily added and altered for different purposes without changing the initial structure of the source documents. This allows multiple perspectives on the original documents and multiple representations of the integrated information which should represent a variety of perspectives. Information use can be extended as source documents form the basis for further information development and adaptation. Because of the linking feature various tracks can be easily followed by non-experts as they travel the information field. Just as in data bases, help and search systems can be used to facilitate access to information in the super document.

**Collective Memory in Generational Communities:** If formalized, collective memory is defined in groups by standard rules and procedures. Collective memory, in the intergenerational archive provides a way in which the collective memory can be built upon and integrated so that it is usable to future generations of learners. (For description see <http://www.vision-nest.com/btbc/kgarden/clearning/wholeclearning.shtml>)

#### **SUMMARY**

Learning theorists believe learning takes place or is enhanced by interaction with the environment, either socially or individually. CML provides learners with interactive experiences on an individual or collaborative team basis. On line computers allow learners a plethora of information on the Internet. By accessing information that is of interest or familiar to them, working in collaboration with others, in intergenerational communities, scaffolding, and using existing databases adding to them, learners in a CML environment have many more opportunities than in traditional settings for acquiring and applying useful knowledge in a psychologically secure environment.



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