Pedagogical framework for online learning

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1. Introduction

The development of new broadband communication services, convergence of telecommunications with computers and recent developments in communication protocol have inspired numerous proposals for the use of these tools in teaching and learning. The integration of computers and communications and their capacity to integrate and interact with one another over a far geographical distance offers unprecedented opportunities for education. The growth of these communication and computer systems, their ease of use and the power and diversity of information transfer give teachers and students access to a world beyond the classroom. This progress has the potential to transform the nature of the learning environment and its processes (Majumdar, 1997, p. 347-352). Recent technological advances, from distributed to interactive and finally to collaborative technology through the Internet and the world wide web encourage the development of a new teaching environment and a paradigm shift in the learning process.

The link between distance learning and telecommunications is becoming even stronger, yielding new solutions to old problems, innovative educational resources and new teaching/learning models. One of the most innovative and promising outcomes of this relationship is online education. This links teachers and learners in a computer network creating a fully-fledged learning community in which all individuals take an active part and make a valuable contribution to the group.

The educational arena of online learning is still in its infancy. While there are many institutions that offer online courses, an in-depth understanding of the pedagogical issues relating to online education remains an unexplored frontier. Many online courses are nothing but web pages combined with e-mail and chat rooms without any pedagogical foundation. Most current online education transfers traditional classroom instruction to an online setting, recasting reading materials as web-based materials which rely on information acquisition and rote learning. Both are low-level learning experiences.

While literature provides some evidence of the effectiveness of using online education (Kearsley et al., 1995, p.37-32), little is known about which learning strategies should be used for education and training. How can we construct these electronic teaching and learning environments so they are founded on specific epistemologies or knowledge bases? What is an appropriate pedagogical framework for online learning?

This paper discusses the characteristics of online education from epistemological and pedagogical perspectives and suggests a conceptual framework for online learning based on cooperative/collaborative learning strategies. It also discusses innovative ways to design online courses to enhance creativity and critical thought processes.

2. Distance education and online learning

Over the past century, the steady evolution of communication technology has considerably influenced the simultaneous development of distance education (DE). The first generation of distance education consisted largely of correspondence courses based on printed material where instances of interaction between the
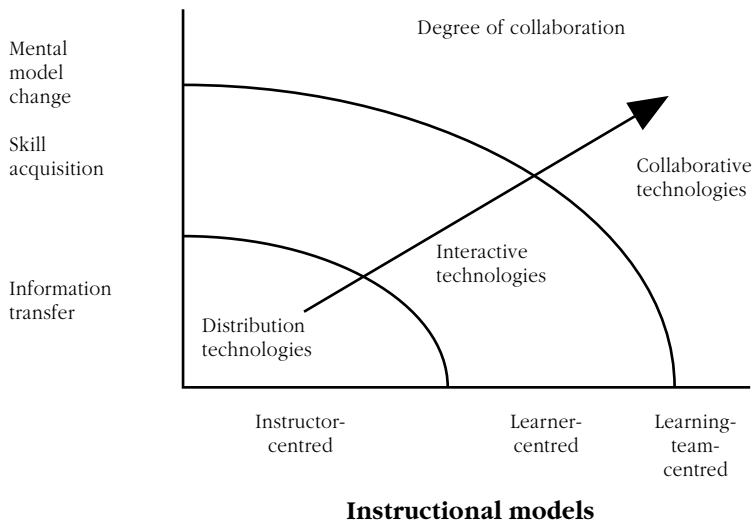
This paper discusses the characteristics of on-line education from an epistemological and pedagogical perspective and suggests a conceptual framework for on-line learning based on co-operative/collaborative learning strategies. The paper also discusses innovative ways to design on-line courses to enhance creativity and critical thinking processes. The author argues that where learning through facts, drill and practices, rules and procedures was more adaptive in earlier days, now learning through projects and problems, inquiry and design, discovery and invention, creativity and diversity, action and reflection is more fitting in the present times. So there is need for an urgent pedagogical shift to meet the demand of the online millennium learner.

Figure 1

Technology, learning objectives and instructional models in three generations of distance education

Learning objectives

Instructional models

tred on learner-to-learner interaction, but rather as an almost totally individual pursuit (Trentin, 1997, p. 261-270). Hardly anything distinguished DE from self-study.

The driving force behind the development of third generation DE systems is redefining learning as a social activity involving extensive use of the computer network. In DE terminology, the third-generation system is also known as online education or network-based education. In this environment all the actors in the learning process – learners, tutors and experts – are connected via a computer network to overcome isolation, enhance group interactivity and promote collective development. Collaborative technology is the foundation of this generation. It supports the learning objectives of mental model change with learning-team-centred education. The learning-team-centred approach creates an environment in which knowledge emerges and is shared through the collaboration of individuals within learning teams.

Kaufman (Kaufman, 1989) characterises the three generations as a progressive increase in learner control, opportunities for dialogue and emphasis on thinking skills rather than mere comprehension. More significantly, it is creating new types of educational organisations. Figure 1 (White Paper on *Distributed learning*, 1996) below illustrates the generations of distance education.

3. Pedagogical framework: objectivism, constructivism and eclectic model

An online educational environment can be developed from two main schools of thought: the objectivist versus the constructivist learning theory. Two different types of online educational environments can be established based on these approaches.

3.1 Online learning based on objectivism

In these learning environments, the students learn individually through compu-

teacher and the learner were few and far between. Distribution technology was the foundation of this generation, which supported the instruction-centred approach and information transfer learning objectives. The underlying pedagogical assumption was transferring information, rather than interpreting or changing it. The second-generation DE system incorporated various media such as television, audio recordings and, in some cases, courseware saved on floppy disks. Teacher and learner interaction remained almost unaltered from that of the first generation, although it was supported by telephone, fax, etc. Interactive technology was the foundation of the generation that allowed the learner to progress at his or her own pace towards skill acquisition. The underlying pedagogical assumptions were a learner-centred approach – interpreting information, not merely receiving it. Thus the first and second generations of DE systems were based primarily on production and distribution of learning materials. Communication between learners was almost non-existent and DE seemed merely designed to bridge the geographical gap. Hence, education was no longer seen as a social activity cen-

ter-mediated communication. They interact with web-based instructional materials stored at remote locations and have minimal interaction with instructors/teachers and peers. As shown in Figure 2, Student A and Student B are geographically far apart and use their own computers to interact with the web-based instructional material stored and delivered by the instructor from a different location.

This type of online learning environment is based on behavioural psychology, where students are presented with information which they repeat back to the teacher (reproduction). It is based on learners' reactions to a particular kind of stimulus that can be modified by rewards and punishments (Inglis, 1996, p. 28-37). The aim is to develop a planned online learning environment with structured, guided but often rigorous study courses and tasks for individual reflection and problem-solving. These courses contain learning objectives, methods, materials and an evaluation scheme defined by the tutor him/herself. The nature and authority of the learner's knowledge involves the learner undertaking and completing the tasks individually. This learning is based on the individual construction of knowledge and reproduction rather than on social processes. It contains the idea that there is a body of objective knowledge that can be delivered to learners through presentation and explanation. Today's online learning is dominated by the behaviourist school of thought and the use/ role of technology as a substitute for a teacher delivering instruction. Current approaches to the online learning environment usually transfer traditional classroom instruction to an online setting, recasting reading materials as web-based materials, lectures as online lecture notes and video clips and discussion as online conferencing (Bourne et al., 1997). These are basically mere Internet-based correspondence courses which rely on information acquisition and reflect low-level learning.

The online learning environment based on objectivism has a number of drawbacks, limitations and shortcomings (Mangal, 1990), as it does not encourage learners to develop higher-order complex skills like creativity, problem-solving, designing and decision-making abilities and the acquisi-

Figure 2

Online learning based on objectivism

WBI

WBI

Student A

Student B

Web-based
instruction (WBI)

Facilitator
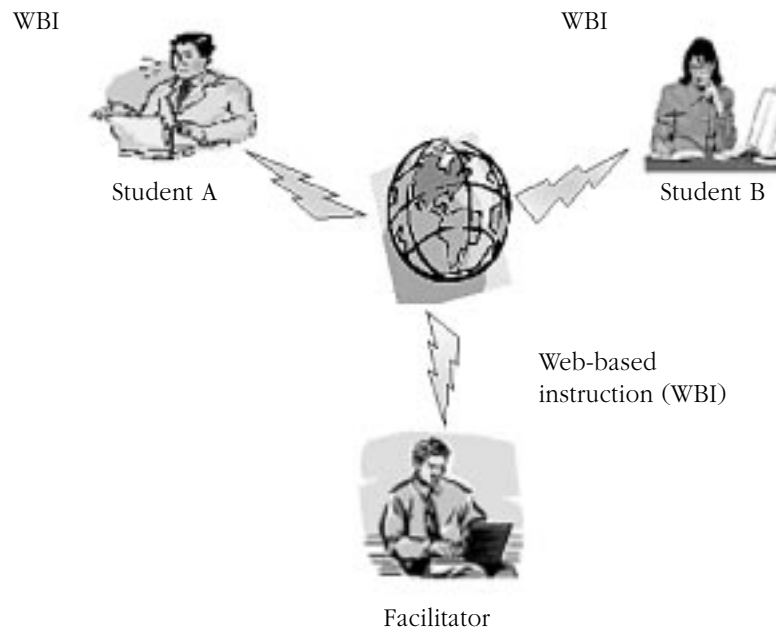
tion of knowledge through social interaction. For this reason it has been subject to several forms of criticism, modification and refinement from contemporary psychologists, such as constructivists.
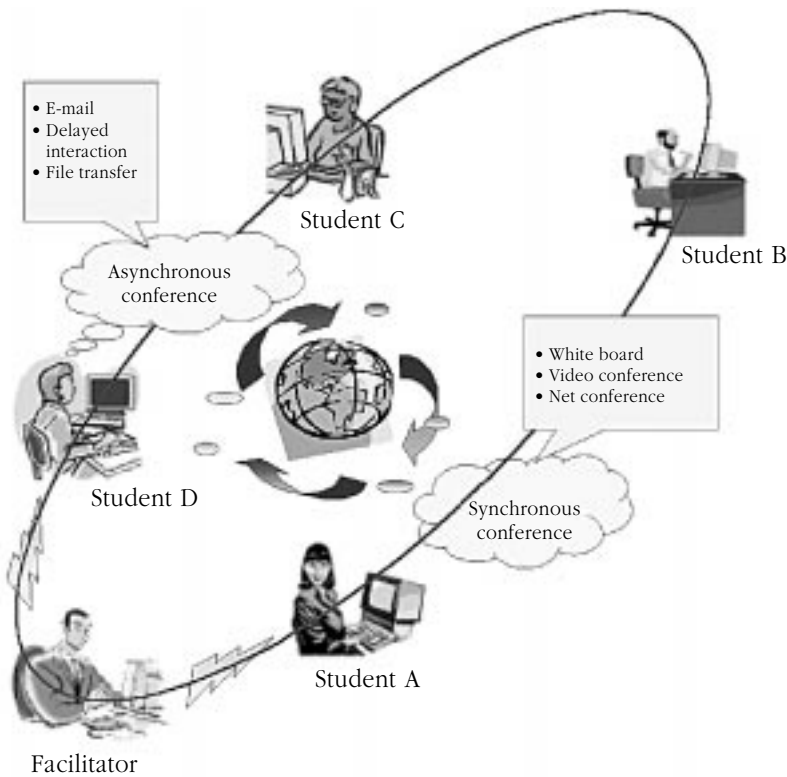
3.2 Online learning based on constructivism

Computer-supported collaborative learning (CSCL) can be understood as an emerging phenomenon of online education that provides a framework to bring individual learners together to achieve a shared learning goal by managing their learning processes. The constructivist school of thought is considered the basis of the CSCL environment. A CSCL environment is shown in Figure 3, where Student A, Student B, Student C and Student D, who are geographically far apart, collaborate, analyse and synthesise in a group, using asynchronous and synchronous communication tools. They have a web-based curriculum and work in a shared learning space to achieve a shared learning goal using their own computers. Learners work together with peers to build knowledge.

Figure 3

Online learning based on constructivism

- E-mail
- Delayed interaction
- File transfer

Student C

Student B

Asynchronous conference

- White board
- Video conference
- Net conference

Student D

Synchronous conference
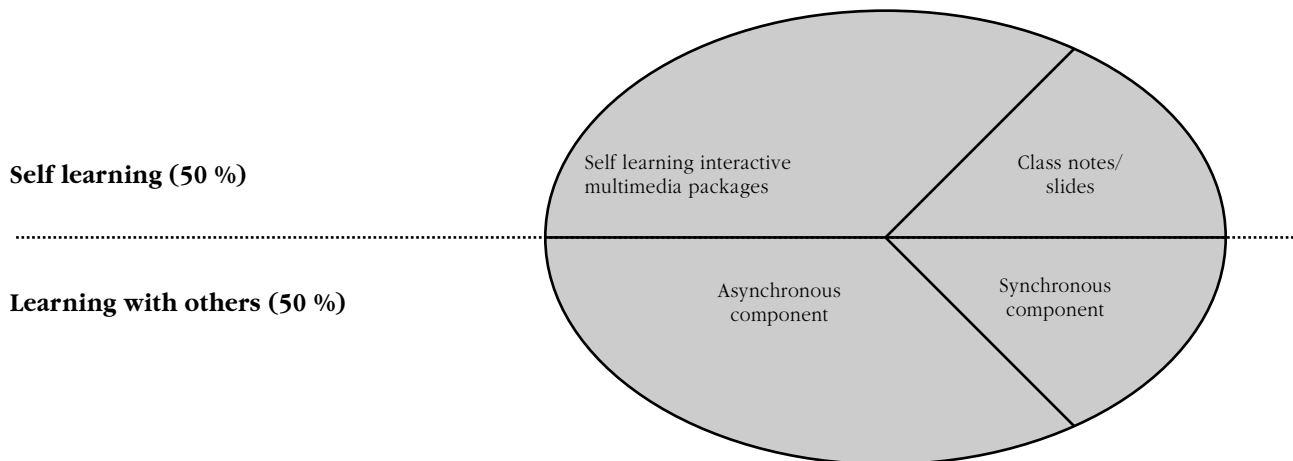
Student A

Facilitator

A collaborative learning environment of this kind develops complex skills like creativity, problem-solving, designing and decision-making abilities (McDonald et al., 1998, p. 6-21). Constructivism can be considered a worldview or ontology that is based on a set of learning theories which fall somewhere between cognitive and humanistic views. To create an effective learning environment from this ontology, an epistemology can be established to help explain how knowledge is formed. The constructivist theory holds that knowledge has to be discovered, constructed, practised, and validated by each learner and that learning involves 'an active struggle by the learner'. Cognitive psychologists totally oppose the stimulus/response and reward/punishment approach of the behaviourists. They argue there is more to learning and behaving than just individual responses to stimuli. The human mind does not accept information in exactly the same form and style as it is conveyed but explores it, interacts with it and reflects on it to construct knowledge from experiences. Pedagogical methods using the constructivist approach include collaborative learning and creating learning situations that enable learners to engage in active exploration and social collaboration. Passive approaches to learning assume that students 'learn' by receiving and assimilating knowledge individually and independently (Johnson, 1979, p. 51-70). In contrast, active approaches present learning as a social process, which occurs through communication with others. The learners actively construct knowledge by formulating ideas into words, and these ideas are developed through the reactions and responses of others. Collaborative learning refers to instructional methods that seek to encourage learners to work together on a given academic task. Collaborative learning is fundamentally different from traditional 'direct transfer' or the one-way knowledge transmission model, in which the instructor is the only source of knowledge and skill (Harasim, *'Online education...'*). The conversation (verbalising), multiple perspectives (cognitive restructuring) and arguments (conceptual conflict resolutions) that arise in cooperative groups may explain why collaborative groups encourage a greater cognitive development than the same individuals achieve when working alone (Sharon,1980, p. 241-247) (Webb, 1989, p.21-29).

It is believed that constructing knowledge requires teaching and learning strategies and an environment which presents learners with knowledge-building structures. There are three distinct constructivist epistemology viewpoints: a personality view, the social view and academic knowledge modes (Joyee et al., 1996). Each of these views provides an important framework for the design and development of online courses. The personality view focuses on the students and their interaction. It considers the individual personality within the context and helps individuals to understand themselves and their relationship to the world. The social point of view centres on the students constructing knowledge together. This framework assumes that knowledge-building is based on the social processes provided by the context. The academic knowledge modes concept, also known as the academic inquiry view, centres on the academic disciplines. This view asserts that the function of schooling is to provide students with the aca-

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Figure 4

Learning components based on proposed eclectic model

Self learning (50 %)

Learning with others (50 %)

Self learning interactive
multimedia packages

Class notes/
slides

Asynchronous
component

Synchronous
component

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demic toolkit to help them construct knowledge. Information processing theory (Lange, 1965) provides a good framework for the use of the academic toolkit. In constructivism, learning is seen as a constructive process in which learners play an active role and learning is based on their cognitive functions. Learners obtain new knowledge by building on their earlier knowledge and their active functioning in continuous interaction with the surrounding world, and from other learners.

Based on constructivist theories of learning, the online education environment can be designed on the assumption that learners themselves are an active agent and that they use social skills to undertake and complete group tasks. One of the limitations of this environment is that 'it does not always produce predictable learning outcomes'. The facilitators should foster the learner's constructive process and not attempt to closely control the process or result. The process of instruction and the role of instructor should be a guide to discovering knowledge and provide expert feedback during knowledge building through structured collaborative learning tasks. The learners themselves control the learning process. As far as the learner's nature and authority of knowledge is con-

cerned, the learners undertake and complete the task in groups, using their social skills and team skills based on their experiences.

3.3 Online learning based on the eclectic pedagogical approach

To ensure a uniform and predictable learning outcome in the CSCL environment based on constructive pedagogy, an eclectic andragogical/pedagogical approach has been proposed. This model combines the most appropriate aspects of both constructivist and behaviourist perspectives. This type of learning, based on the eclectic andragogical/pedagogical approach deriving from the two perspectives, will minimise the transactional distance as propounded by Moore (Moore et al., 1996), accommodating learners with multiple learning styles and learners who are not ready for fully self-directed learning. This approach assumes that learners will acquire 50% of knowledge by themselves and the other 50% through collaboration with others. Collaborative learning includes both synchronous and asynchronous learning components. However, much of the emphasis will be on asynchronous components due to their inherent advantages of being adaptable to any

time and place. Synchronous interactions happen in real time, when learner and instructor are online at the same time and have direct contact. In contrast, asynchronous interactions take place at the learners' and teachers' convenience. The key feature of asynchronous learning is anytime, anywhere learning which utilises the conferencing facilities of the web. It may result in both immediate and delayed feedback. Immediate feedback happens when the program automatically links documents. Delayed interaction occurs due to the time required for the other learner to respond to list servers and forum and e-mail messages. Synchronous interactions require a set of tools that enable learners to see, hear and share applications across the Internet. Complex topics can be explained directly using tools such as whiteboards, Internet relay chat, audio and video conferencing.

Figure 4 illustrates this approach.

4. Collaborative learning and online education

Various theorists from socio-cultural and situated learning have stressed the importance of social interaction. It has been observed that 'students do not like to work alone, they like to share ideas with one another' (Chu et al., 1999, p. 334-338). This advantage of social interaction (learning) was difficult to incorporate into online learning programs for geographically distant learners since collaborative learning and online learning are two different education traditions. But today the collaborative/group tools can be used for social negotiation and group learning, enabling learners in groups to interact with more capable peers. Learning is distributed among the learners. Knowledge comes from a community of learners who interact. Students actively learning in co-operative groups have demonstrated an ability to generate higher-level reasoning strategies, a greater diversity of ideas, more critical thinking, and more creative responses than those learning individually or competitively (Schlechter, 1990, p. 329-341).

Various socio-psychological mechanisms make collaborative learning effective.

They include: (a) conflict or disagreement, (b) the alternative proposal, (c) (self-) explanation, (d) internalisation, (e) appropriation, (f) shared cognitive load, (g) mutual regulation, and (h) social grounding (Dillenberg et al., 1995, p. 10-6 to p. 10-13).

The 'conflict between learners' mechanism postulates that when disagreement occurs between peers, social factors prevent learners from ignoring conflict and force them to find a solution. Those who support the alternative proposal referred to as 'confirmation biases' tend to design only experiments that confirm their hypotheses and to disregard any empirical finding that contradicts their hypotheses. '(Self-) explanation' occurs when a more knowledgeable peer explains a topic to another. One receives an explanation and the other benefits from articulating and integrating various pieces of knowledge. 'Internalisation' is the process of learning by verbalising in conversation. 'Appropriation' occurs when one student learns from watching and working with a more skilled partner. Apprenticeships are one form of appropriation. 'Shared cognitive load' is the sharing between learners of a cognitive burden presented by the task. 'Mutual regulation' is the way of regulating a partner's activities. 'Social grounding' is the mechanism by which an individual attempts to maintain the belief that his/her partner has understood what he/she meant, at least to an extent sufficient to carry out the task at hand. Group composition, task features and communication media play an important role in implementing collaborative learning effectively.

It has been argued (Harasim, *'Online education...'*) that the collaborative potential of computer conferencing enables learners to participate actively in their own knowledge building or knowledge creation in three ways: idea generation, idea linking, and idea structuring.

The four fundamental features of collaborative learning are:

❏ learning centred on student activities rather than focused on the teacher;

❏ emphasis on students assisting one another to find answers to areas of common inquiry;

❏ learning based on solving problems through analysis and discussion among learner groups;

❏ emphasis on creative and critical thinking.

But the question is, do we follow the above framework of collaborative dimension while we design web courses? Are critical thinking and problem-solving skills our strategies for web-enhanced creative processes? Do we exploit all the conferencing facilities offered by the web? Simply making online conferencing available and asking learners to use it is not collaborative learning. Developing online course material for enhancing creativity requires more than an understanding of hard technology i.e. bits and bytes, electronics and satellite technology, CGI, search engines and HTML. What we need to understand is the 'soft aspect' of the technology which provides a framework for developing courses in the web to enhance creativity in a collaborative environment.

A framework for pedagogical techniques for computer-mediated communication has been organised into four communication paradigms: information retrieval, electronic mail, bulletin boards and computer conferencing. They have been further classified into four techniques as characterised below (The online report on pedagogical techniques, 1995);

❏ one-alone technique (the online resources paradigm): online database, online journals, online libraries and online applications;

❏ one-to-one techniques (the e-mail paradigm): learning contracts, apprenticeships, internships and correspondence studies;

❏ one-to-many techniques (the bulletin board paradigm): lectures, symposia, and skits;

❏ many-to-many techniques (the conferencing paradigm): debates, role-plays, discussion groups, brainstorming, forums, transcript-based assignments, etc.

Most online courses use the first three classes of techniques, ignoring the many-to-many techniques, which are the core

of a collaborative learning environment. Some of the key cooperative learning techniques include (Harasim, *'Online education...'*) (Harasim et al., 1995):

❏ partner activities and round table: sharing and summarising ideas via e-mail;

❏ asynchronous conferencing: discussion and reflection via bulletin board;

❏ synchronous conferencing: real time conferencing via relay chat, net meeting and video conferencing tools;

❏ group investigation: selecting a topic in a group, exploring it individually and then compiling collectively;

❏ project-based learning: learning through project planning and development in a team;

❏ other activities: panel discussions, symposia, debates, role-plays, discussion groups, brainstorming and team competition in a group, etc.

5. Creative thinking on the web

Researchers such as Davis (Davis, 1992), Perkins (Perkins, 1986) and de Bono (de Bono, *Thinking course 3rd ed.*) have championed instructional techniques that address students' independent or creative thinking. Online approaches have provided many tools and the environment for implementing instructional techniques that address students' independent or creative thinking. Web browsing software now exists to explore and search, find patterns and relationships, rank ideas, view results and send findings to peers and instructors. Clearly, the web is an ideal tool to nurture students' willingness to take risks, their commitment to tasks, curiosity, openness to experiences, broad interest, originality, imagination, intuition, attraction to novelty, artistic ability, metaphorical thinking, problem-finding skills, elaboration of ideas and readiness to break away from the norm – all of which are attributes of creative people (Davis, 1992) (Starko, 1995) (Young, J. G. 'What is creativity?', p. 77-87). The anonymity of alter egos and pseudo roles during electronic discussions encourages students to experiment with

ideas and take risks in expressing thoughts (Harasim et al, 1995). Some of the proposed techniques for how the web can enhance creativity in the electronic environment are:

❏ brainstorming and reverse brainstorming: focus on idea generation;

❏ assigning thinking roles: each person in the roundtable is assigned a role;

❏ creative writing: one starts writing, another expands the idea;

❏ just suppose: just suppose you are Education Minister – what would be your priority?;

❏ idea-spurring questions: suggestions to modify and improve;

❏ semantic webbing: propose a word in the middle of a semantic map, suggest attributes related to the concept;

❏ simulation and role-play: role-playing in a simulated environment.

It has been observed that discussion and interaction under asynchronous conferencing in a different time and different place tend to be more extended and engaging for learners than the traditional environment. Learners can give their opinion in a much more relaxed way and in their own time, which produces a congenial environment for creative reflection.

6. Critical thinking on the web

Critical thinking is reasoning, reflective thinking that focuses on deciding what to believe or do. Learners learn to look at a concept or phenomenon, aware of their own biases, and thus approach the situation objectively and logically. Creative thinking, on the other hand, is the ability to form new combinations of ideas to fulfil a need or to understand a specific natural occurrence. Despite extensive independent avenues of thought, enhancing critical thought pathways may be an equally strong dimension of the web. Some of the emerging ideas on critical thinking in the web are:

❏ graphic organiser: emphasising spatial representation as in the model, Venn diagram, etc. It facilitates critical thinking by helping learners to sort out the hierarchy and logical flow of ideas;

❏ ranking methods: to rank and categorise brainstorming ideas in the web;

❏ reflection: writing, thinking, activities for reflection and critical evaluation;

❏ mock trial and debate: encourages development of arguments;

❏ case-based reasoning: case study and comments.

Any activity which encompasses searching for causes and effects, finding patterns and relationships, ranking ideas, developing timeliness and forming taxonomies is a worthwhile exercise of critical thought (Bonk et al., 'Learner-centered web instruction...' p. 167-178). The web offers plenty of opportunities to enhance cause and effect relationships using simulation and animation programs in Web/CBT packages.

7. Guiding principles

There are several guiding principles for designing effective online learning. These include:

❏ presenting a problem-based learning environment,

❏ presenting authentic and realistic tasks,

❏ focusing on knowledge building,

❏ promoting active learning,

❏ using multimedia effectively,

❏ mixing appropriate instructional strategies,

❏ designing appropriately structured discussions,

❏ presenting a contextual learning environment,

❏ focusing on learning in groups.

		Table 1
Dimensions	**Undesirable**	**Desirable**
Pedagogical basis	Instructive model	Eclectic model based on constructivism
Learning focus	Content	Learning to learn
Learning strategies	Solely interactive	Collaborative and interactive
Learning goal	Externally controlled	Autonomous
Learning theory	Behavioural	Cognitive
Teacher role	Didactic	Facilitative
Delivery modes	Fixed	Open
Learning approaches	Surface	Deep
Learning structures	Rigid	Flexible/modular
Instructional models	Instructor-centred	Learning-team-centred
Learning objectives	Information transfer	Mental model change
Learning methods	Passive	Active

The role of a student in an online environment is that of a learner, as well as a collaborator and team member. There is a paradigm shift as well as an explosion of knowledge in educational practice (Majumdar, 1999, p. 72-73) in teaching and learning in a network environment. Where learning through facts, drill and practices, rules and procedures was more adaptive in earlier days, learning through projects and problems, inquiry and design, discovery and invention, creativity and diversity, action and reflection is more fitting in the present. A need therefore exists to develop a conceptual framework for the pedagogical dimensions of online learning based on collaborative learning strategies. The desirable shift required in each of the pedagogical dimensions of online learning is presented below:

8. Implications and future work

The way a learner learns in an online setting has not been extensively studied. Designing and developing effective online courses requires a new approach to various pedagogical dimensions of the online environment. It requires acquiring knowledge of new media from communication research, gaining a pedagogical perspective from educational research and learning about group interaction from socio-psychological research. Each of these can be adapted, applied and integrated to help explain what happens in online classes and why (Coppala et al., 1999). A teaching designer using online collaborative learning must integrate increased group work, work-based learning and problem-solving to encourage higher-order thinking. Given the endless possibilities for higher-order thinking (Majumdar, 2000) and teamwork, the worldwide web probably has the power to generate novel learning strategies which will eventually be embedded in cognitive, social and cultural contexts. If the design of online courses incorporates the desired changes in pedagogical dimensions, the difference between training on the web and traditional methods could be profound. Let us work together to initiate future research into the issue.

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