Higher education suffers from its stress on the individual acquisition of knowledge and skills (competencies). Hence, the validity of the study programmes can be questioned because certain learning goals are difficult to achieve in an individual context. Examples abound such as negotiation skills, chairing a meeting, monitoring a discussion, and interviewing decision-makers. It is therefore no wonder that curriculum evaluation at the university level (the so-called ‘visitation’ reports or academic audits) is critical about skills development in general and collaborative work in particular. Learning and working together as a guiding didactic principle has affected the use and position of information and communication technology (ICT) resulting in a marked change in emphasis on ICT use in which students, educational staff and support staff all work together. This approach has a dual function. It supports the use of effective discursive learning methods (make explicit, discuss, reason, and reflect, convince) while allowing for the acquisition of essential social and communication skills (Dillenbourg, Baker, Blaye, & O’Malley, 1995; Mirande, Riemersma, & Veen, 1997).

Current thinking on the need for the acquisition of competencies in higher post-secondary education is in line with the vocationalist and the reflexive views of learning posited by Goodyear (1998). The vocationalist view of learning, one of operational competence, holds that employers want higher education to attend more closely to what they consider they need in the graduates they recruit. These demands may include the kinds of specialised technical knowledge acquired by some students on some courses, but increasingly they refer to generic skills or competencies (otherwise known as core skills or transferable skills). Frequently mentioned generic competencies include literacy, numeracy, communication, foreign language, leadership, teamwork and IT skills (e.g., Assiter, 1995; Harvey & Mason, 1996). Harvey and Knight (1996) conclude that organizations that recruit graduates are looking, above all else, for transformative potential. That is, they want new graduates entering their employ to have the capacity to transform their organization, not merely to enhance its productivity and competitiveness along current lines.

Reflexivity, Goodyear’s second conception, is best articulated in the writing of Ronald Barnett (e.g., 1997a; 1997b). He argues that individual reflexivity (‘the capacity to go on interrogating one’s taken-for-granted universe’) is necessary for dealing with an essentially unknowable modern world. Higher education needs to respond by:

• supporting the student in his/her acquisition of discursive competence;
• encouraging self-reflexiveness by framing the student's initiation into a field of thought such that the student see its essential openness and how (s)he may be an actor in it;
• encouraging informed but critical action by understanding the power and limitations of the field as a resource for action (Barnett, 1997a).

These two views of learning cannot be operationalised in traditional contiguous didactic (academic) teaching and learning settings that are more often than not both individual and competitive in nature. The generic skills and competencies in the vocationalist and reflexive views require the implementation of a different approach to learning in a setting where there are shared realistic and relevant problems, where there are shared needs and goals, where there is room for multiple perspectives on the problems and their solutions, where there are shared responsibilities both for the process of achieving a final product and for the product itself, and where there is mutual trust between the participants such that they are valued for their contributions and their initiative. In other words, this can only be achieved in a collaborative and/or cooperative learning setting.

1. LEARNING PARADIGMS IN THE TWENTIETH CENTURY

Taking a little poetic licence with respect to the beginning of the twentieth century, we can say that thinking about learning began with Dewey and his ideas on pragmatism, was followed by Hull (associationism) and Skinner (behaviourism), dabbled with Gagné and Ausubel (cognitivism and meaningful learning) and ended where we are now with different strands of constructivism. For some of us, this is full circle. Notable names (and paradigms) and in approximate chronological order are: Watson and Skinner (behaviourism), Bruner (discovery learning), Ausubel (meaningful learning), Piaget (constructivism), Rumelhart (schemata), Schank and Abelson (scripts), Vygotsky (dialectical constructivism), Spiro (cognitive flexibility), Bransford (problem-based learning), Brown (situated cognition), Salomon (distributed cognition) and Engeström (activity theory).

Over the past century there have been (at least) three major paradigm shifts within the field of psychology. Most popular in the first half of the twentieth century and still widely practised after 80 years, behaviourism involves the study of changes in human behaviour. Cognitivism, which looks inside the ‘black box’ of the mind to determine mental activity and structures as if we were dealing with a computer, enjoyed popularity from the early 1970s until recently. The newest paradigm involves the more social-centred view of constructivism, in which we differentiate and support the individual person’s knowledge construction of the world in relation to others as opposed to the existence of immutable, objectivist truths. Each of these will be discussed along with parallel changes in the field of educational technology. A little more emphasis will be placed upon constructivism due to its important place in thinking about collaboration, as is the case in computer-supported collaborative learning (CSCL).
1.1 Behaviourism

In 1913, John Watson put forth the notion that psychology did not have to use terms such as consciousness, mind, or images (Burton, Moore, & Holmes, 1995), but that the behaviour itself was enough. Based upon this behaviourist paradigm, design models came into use. These models, though differing in a number of ways, all include emphasis on success of instructor/teacher instead of learner, detailed task analysis used to establish behaviour objectives, use of small groups, specifically planned lessons, high learner response requirements, feedback, and data collection related to accuracy and speed.

B. F. Skinner took this a step further and tried to explain almost every type of human behaviour in terms of stimulus response chains. In his eyes, every good behaviour must be rewarded. Readers of this book who are thirty years and older will probably have had many stamps and gold stars in their primary education books, all intended as direct rewards of good work and behaviour. Behaviourism strongly influenced education and continues to do so (e.g., drill and practice computer programs which give positive feedback for correct responses are still widely in use and are very good at what they are intended to do), but finally turned out to be too restricted to form the basis of all learning (cf. the debate between Skinner and Chomsky on the learning of language).

1.2 Cognitivism

Cognitive psychology's reaction to the inability of behaviourism to account for much human activity arose mainly from a concern that the link between a stimulus and a response was not straightforward, that there were mechanisms that intervened to reduce the predictability of a response to a given stimulus, and that stimulus-response accounts of complex behaviour, like the acquisition and use of language, were extremely complex and contrived (Winn & Snyder, 1996).

Cognitive psychology focuses on mental processes that operate on stimuli presented to the perceptual and cognitive systems. According to cognitive psychology, mental processes largely determine whether or not a response is made, when it is made, and what it is like. While behaviourists claim that mental processes cannot be studied because they are not directly observable and measurable (and that to measure them is to change them), cognitive psychologists claim that these processes must be studied because they can more adequately explain behaviour.

Learning is described as a change in the cognitive structures in the mind of the learner. These changes may be supposed by a change in behaviour, or by a more direct measure of cognition such as learner created representations of concepts and their mutual relations. Instruction in this paradigm is based upon the idea (Gagné, 1985) that the optimal conditions for learning depend on the goal of the learning process and that by analysing the goals of education one can devise how the achievement of those goals can be met. These theories assume that one can describe a subject matter domain in terms of learning goals, and can then develop instruction for each of the learning goals - taking the optimal conditions of learning for each goal into account.
1.3 Constructivism

Constructivism is not an approach to nor a model for instructional design, but rather a philosophy of learning based on the idea that knowledge is constructed by the learner - and eventually 'the one(s) who know(s)' - based on his/her/their mental activity (Kirschner, Carr, Van Merriënboer, & Sloep, 2002; Stahl, 2003). Learners are active in seeking meaning. Consistent with this view, learning must be situated in a rich context, reflective of real world contexts, for this constructive process to occur and for transfer to environments beyond the school to be possible. The first to argue this view was John Dewey!

It has often been stated that the only contribution of the United States of America to the realm of philosophy is the notion of pragmatism (Dewey, 1903). John Dewey, the father of pragmatism, argued that the traditional correspondence theory of truth, according to which the true idea is one that agrees or corresponds to reality, only begs the question of what the ‘agreement’ or ‘correspondence’ of this idea with reality is. He maintained that an idea agrees with reality, and is therefore true, if and only if it is successfully employed in human action in pursuit of human goals and interests, that is, if it leads to the resolution of a problematic situation.

He further argued in School and Society (1907) and Democracy and Education (1916) that education should not be viewed as merely a preparation for civil life, during which disjointed facts and ideas are conveyed by the teacher and memorised by the student only to be utilised later on. The school should rather be viewed as an extension of civil society and continuous with it, and the student should be encouraged to operate as a member of a community, actively pursuing his or her interests in cooperation with others. Dewey believed that a process of self-directed learning, guided by the cultural resources provided by teachers, best prepares a person for the demands of responsible membership in the democratic community. Knowledge is then acquired by “going over one’s past experiences to see what they yield.” (p. 157). In other words, it should not be assumed that knowledge is transferable as an automatic consequence of assigning meaning to an experience. Knowledge is relatively specific to the purposes for which it was acquired.

In Democracy and Education (1916) too, he remarked that in spite of the fact that teaching by pouring in and learning by passive absorption are universally condemned, they are still entrenched in practice. Education was, for Dewey, not an affair of ‘telling’ and being told, but an active constructive process (as we see, he was years ahead of his time), which unfortunately is as generally violated in practice as it is conceded in theory. Applying this philosophy to education means that:

- education should be preparation for life,
- solving problems is important - thus real life situations should be used,
- teaching methods should be varied and flexible,
- education should be action-oriented, and
- needs and interests of the students must be considered.

Constructivism, as is pragmatism, is neither an approach to nor a model for instructional design. It is a philosophy (of learning) that holds that learners are active in seeking meaning. Consistent with this view, learning (not teaching!) must be
Constructivism holds that in order to learn, learning needs to be situated in problem solving in real-life contexts where the environment is rich in information and where there are no right answers (embedded knowledge). The tasks must be authentic and are best learnt through cognitive apprenticeship on the part of the learner in a rich environment. Meaning is negotiated through interactions with others where multiple perspectives on reality exist. Reflexivity is essential and must be nurtured. Finally, all of this is best (and possibly only) achieved when learning takes place in ill-structured domains (Kirschner, 2000). Taking these one for one:

- **Situated learning and authentic tasks**: Situated learning (Brown, Collins, & Duguid, 1989) is a method of ensuring that students learn to understand concepts anchored within the context of an area of study. Instead of abstracting unrelated bits of knowledge in an area of study, a student learns about a subject area by immersion in that culture. The objective is to produce a student who, if studying within a certain area or professional domain, understands how a practitioner within that domain acquires knowledge, finds information in his or her field, and integrates this knowledge to solve problems in that domain. A rich context for problem solving becomes part of this component.

- **Cognitive apprenticeship**: In cognitive apprenticeship, a teacher models those thought processes that characterise an expert in a particular field (Collins, 1988). Experiences are provided for the student that mimic the apprenticeship programs of adults in trades, or teachers in internship. Although it is not possible to immerse the student to the extent that an internship would imply, through the use of simulations and meaningful experiences, the student learns the ways of knowing of an expert.

- **Social construction of shared perspectives**: Von Glasersfeld (1988) discusses the social construction of knowledge where concepts are developed in a process of fine-tuning involving interaction with others. Group interaction aids this process, because it exposes the learner to multiple perspectives about a theme. Collaborative learning that emphasises the need to examine an issue from all sides gives students the understanding of various points of view.

- **Nurturing reflexivity**: Constructivists believe it is important to encourage reflexivity whereby students become aware of how their own thinking processes work. Helping students to think about how they are arriving at conclusions, or how they go about solving problems, helps form more meaningful links between knowledge and develops more elaborate cognitive schemata.

- **Ill-structured problem domains**: Spiro, Coulson, Feltovich and Anderson (1988) developed the Cognitive Flexibility theory after they discovered that many learning failures resulted from cognitive oversimplification and the inability to transfer knowledge and apply it to new cases. In many cases, the design of learning involved the use of typical cases to explain a concept. The solutions to these typical cases were usually too obvious for students; thus many students could not solve problems that involved more complex sets of
factors. To counter these problems they suggested the need for instructional systems that allow students to revisit “the same material, at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives” (p. 28). The idea is that many cross-links may occur, and conceptual richness will develop as a student spends time investigating the various connections between themes or concepts.

Dalgarno (1996) applied these constructivist starting-points to a design model based upon ten principles:

<table>
<thead>
<tr>
<th>1 Learner control over content and sequence</th>
<th>2 Learner control over learning strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The learners have some control over what they attempt to learn and when, to maximise the chance that they will be able to relate new knowledge to prior experience.</td>
<td>The learner should have some say in the methods of teaching and learning employed, as different learners will construct their knowledge in different ways.</td>
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<tr>
<th>3 Top-down organisation</th>
<th>4 Content in context</th>
</tr>
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<tbody>
<tr>
<td>Where content is provided to learners, it should be sequenced in a top-down fashion, providing an overall picture before specific facts and skills are learned.</td>
<td>Where content is provided to learners, it should be provided within a context, and to assist with generalisation and transfer to other situations, multiple contexts should be provided.</td>
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<tr>
<th>5 Discovery</th>
<th>6 Zone of proximal development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learners should undertake activities that allow them to put new skills into practice in realistic contexts.</td>
<td>The learners should undertake activities that are currently just beyond their ability, but with assistance provided to enable them to successfully complete activities.</td>
</tr>
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<tr>
<th>7 Authentic activity</th>
<th>8 Articulation and discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>The learners should undertake activities that allow them to put new understandings and new skills into practice in realistic contexts.</td>
<td>The learners should undertake activities that require them to articulate their knowledge representations and to discuss their understanding of ideas with other learners as this will help them to develop their knowledge.</td>
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<tr>
<th>9 Metacognitive strategies</th>
<th>10 Intrinsic motivation</th>
</tr>
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<tbody>
<tr>
<td>The process that the learners use to discover information and principles should be valued and the learners should be encouraged to monitor their own learning and to use appropriate metacognitive strategies.</td>
<td>The learners will only learn if they are motivated in such a way as to allow them to apply their attention to the piecing together of the concepts to be learned. Ideally this motivation should be intrinsic to the tasks learners carry out.</td>
</tr>
</tbody>
</table>

Figure 1. Constructivist principles (Dalgarno, 1996).
The term constructivism has come to serve as an umbrella term for a wide diversity of views. It is well beyond our purposes to detail these similarities and differences across the many theories claiming some kinship to constructivism. However, all theories seem to be committed to the view that learning is an active process of constructing rather than acquiring knowledge, and instruction is a process of supporting that construction rather than communicating knowledge (Duffy & Cunningham, 1996). The common ground of constructivism could be summarised as: “Instead of presupposing knowledge is a representation of what exists, knowledge is a mapping, in the light of human experience, of what is feasible.” (Von Glasersfeld, 1988, p. 134).

Although Dalgarno’s model provides a good overview of the central concepts in constructivism and how these relate to the overall design of an educational curriculum and the use of collaboration is advocated, no information is provided that helps a teacher/designer on how s/he should proceed when designing a (computer-supported) collaborative learning setting.

2. MULTIPLE COLLABORATIVE LEARNING ENVIRONMENTS

Many educational institutions have begun to implement cooperative and/or collaborative learning in their curricula. One of the best discussions on collaborative and cooperative learning is the discussion by Panitz (n.d.). According to him, collaboration is a philosophy of interaction and personal lifestyle, while cooperation is a structure of interaction designed to facilitate the accomplishment of an end product or goal through people working together in groups.

Although many researchers have addressed the differences between the two (Brandon & Hollingshead, 1999; Cohen, 1994; Dillenbourg, 1999; Lehtinen, Hakkarainen, Lipponen, Rahikainen & Muukkonen, 1999; Panitz, n.d.), they share many common assumptions and areas of agreement (see Chapter 2 by Lipponen, Hakkarainen and Paavola, this volume, for an overview of orientations/practices):

- learning takes place in an active mode;
- the teacher is more a facilitator than a ‘sage on the stage’;
- teaching and learning are shared experiences between teacher and student;
- students participate in small-group activities;
- students must take responsibility for their learning;
- discussing and articulating one’s ideas enhances the ability to reflect on one’s own assumptions and thought processes;
- students develop social and team skills through the give-and-take of consensus-building;
- students profit from belonging to a small and supportive academic community;
- students experience diversity, which is essential in a multicultural democracy (Matthews, Cooper, Davidson & Hawkes, 1995).

Although these commonalities far exceed the differences, for the sake of clarity we (and all others chapter in this volume) will adhere to the distinction by Dillenbourg in 1999: “In cooperation, partners split the work, solve subtasks
individually and then assemble the partial results into the final output. In collaboration, partners do the work ‘together’.” (p. 8). However, this operationalisation of cooperation and collaboration (shared by many researchers) is, in our opinion, not adequately substantial to guide the design of CSCL (see also Strijbos, Martens, & Jochems, in press).

3. THE NEED FOR SYSTEMATIC CSCL DESIGN

Most research and design on CSCL focuses on surface characteristics of the environment, the collaboration or the learning paradigm. Examples are studies of the (a)synchronicity of an environment, the optimal size of a group or whether the group was busy with problem-based or project-centred learning. In order to determine, for example, optimal group size, students’ collaborative effort in different environments (synchronous, asynchronous, shared workspaces, et cetera) and/or educational settings (case-based, problem-based, project-based, et cetera) is compared.

Moreover, authors are often vague about the exact nature of the collaboration, making it even more difficult to compare effects and to draw conclusions. This surface level approach disavows fundamental differences between environments and educational forms that are the actual determinants of learning and behaviour. Was ICT actually necessary? What was the nature of the problem or project? Did the learners have to design something or prove something? Was the goal of the problem or project to diverge and be creative (design a building) or to converge and be specific (diagnose a sickness)? Who determined the goal and/or content of a project, the way it was to be solved and the nature of a correct answer or solution? Were the learners evaluated in a competitive or collaborative way?

This surface approach resembles the myriad of comparative research and educational design studies relating to the use of different media in education (Clark, 1983). In his landmark review, Clark argues that researchers tend to focus on the media used and surface characteristics of the education they provide. As a consequence, comparative research tends to be inconclusive and the learning materials developed tend to be unreliable at best and mathemathantic (Greek: \textit{mathema} = learning, \textit{thanatos} = death) at worst.

A second problem is that educational institutions tend to take traditional classroom ideas and pedagogy and substitute them into non-contiguous collaborative learning environments. The assumption is that, since these environments have features that allow the interaction that we see in the classroom (e.g., messaging, real-time meetings, shared applications), traditional pedagogy can be used. The proximate result is often disgruntled or disappointed students and instructors, motivation that is quickly extinguished, poorly used environments, wasted time and money, and showcase environments that are often not much more than computer-assisted page-turning. The result is the same as with the first problem, the death of learning.
3.1 A framework for the systematic design of CSCL

As a solution to research problems and disappointing research findings, a framework for designing CSCL environments is proposed. Most systematic design process models center on designing effective conditions for the attainment of individual learning outcomes (Van Merriënboer, Kirschner, & Kester, 2003) and attempt to control instructional variables to create a learning environment that supports the acquisition of a specific skill (i.e., student A will acquire skill B through learning method C). This is complicated by the use of groups in the case of collaboration. A multitude of individual and group level variables affect the collaborative learning process, making it practically impossible to predefine the conditions of learning or instruction for a group setting so that interaction and competency development are controlled.

Instead of a classical causal view, the design of collaborative settings requires a more probabilistic approach to design, as shown in Figure 2 (Strijbos, Martens, & Jochems, in press). This distinction corresponds with the one made by Van Merriënboer and Kirschner (2001) between the ‘world of knowledge’ (the outcomes) and the ‘world of learning’ (the processes). In the world of knowledge, designers construct methods by which given learning goals in a specific subject matter domain can be attained by the learner. In the world of learning, designers focus on methods supporting learning processes rather than on the attainment of predefined goals.

![Figure 2. Causal and probabilistic views of design.]

This probabilistic view implies that more attention should be paid to learning and interaction processes. Due to the interaction between learners, each member of a group may acquire a given skill by means of the chosen method, but may be equally likely to acquire only a part of the skill, or the skill together with other unforeseen
elements. It might even be the case that the chosen method is abandoned by the group and replaced by another more idiosyncratic method for that group. The question is not what specific educational techniques and collaborative work forms cause. It is rather what they actually afford, which can be referred to as educational affordances of a learning environment (Kirschner, 2002).

4. AFFORDANCES

James Gibson originally proposed the concept of affordances in 1977. In his evolutionary psychological thinking, affordances refer to the relationship between an object’s physical properties and the characteristics of an actor (user) that enables particular interactions between actor and object. According to Gibson (1977) “the affordance of anything is a specific combination of the properties of its substance and its surfaces with reference to an animal.” (p. 67). In other words, it is not a specific property of a thing, but rather the combination of that property and the characteristics of a potential user. A pond affords a surface to walk on for certain species of flies, a place to drink for certain land animals, and a living environment for certain species of fish. Don Norman (1988, 1990) and Bill Gaver (1991, 1996) appropriated the term as a conceptual tool for discussing the design of interactive systems and respectively speak of perceived and perceptible affordances. In other words, it is not only about the existence of the affordance itself, but also of its perceptibility to the prospective user (i.e., being there is not enough, it also has to be seen as such/for what it is meant). Here Norman and Gaver deviate from Gibson’s original concept of affordances that did not include the constraint of perceptibility. Therefore, a hidden door is in Gibson’s view still an affordance while it is not in Norman’s or Gaver’s view, because hidden or not, a door intrinsically affords the passing from the one room to the other. Although the concept of affordances is developed in a totally different knowledge domain (that of ecological psychology), the concept and its principles can be applied in the design of CSCL environments as well.

Although every object has specific affordances, what educational researchers and designers are actually dealing with are not the affordances themselves, but rather the combination of the perceptible (Gaver, 1996) or perceived (Norman, 1990, 1999) affordances, the constraints that are placed upon them, and the conventions regarding the affordance and its use. What we see on a computer screen is not the affordance, but rather the visual feedback advertising the affordance - the perceived affordance. When affordances are perceived, a link between the perception and an action can result: the perception-action coupling. These perceived affordances are limited by physical (you cannot see through opaque glass), logical (you do not put a window on the bottom of a door), and cultural (you do not put a window in a toilet door) constraints and cultural conventions (you do not interrupt a conversation).

Physical constraints are closely related to affordances in the pure Gibsonian sense. Physical limitations constrain possible operations. A square peg cannot fit into a round hole and a cursor cannot be moved outside of a screen.
Logical constraints use reasoning to determine the alternatives, thus, if we ask a user to click on five locations and only four are immediately visible then the (experienced) user knows, logically, that there is still one location left, but that it must be somewhere not visible at that moment and will look and see if there is a scroll-bar on the right side of the screen and scroll down to see the alternative that was not originally visible.

Cultural constraints are learned conventions shared by a group. Designing a button for display on a monitor and saying that it ‘affords clicking’ is wrong. Without a mouse or a touch screen clicking does not exist, and with a mouse or touch screen the user can click on any pixel on the screen! The button provides a target, helps the user know where to click, and probably even cues what the user can expect if (s)he clicks on it, but in the words of Norman “(...) those aren’t affordances, those are conventions, and feedback (...)” (Norman, 1999, p. 40). In other words, the designer has introduced a cultural convention that has been learnt and reinforced through feedback, namely that an object on a screen that looks a certain way will also act in a certain way, and lead to a certain outcome. An example of such a convention is the earlier mentioned scroll bar on the (right) side or bottom of a screen which tells us that there is more text below or to the right and that by clicking in the area and ‘dragging’ it down or to the right, the text will scroll up or to the left! This is known as the ‘outside-in’ convention. Software programs in the Adobe® suite use the ‘inside-out’ convention, namely that the text moves in the direction that the cursor is moved, but to differentiate this they used a hand to symbolise grabbing the text. Such conventions prohibit some activities while encouraging others. Conventions - according to Norman - are arbitrary yet stable and violating them often leads to conceptual and usage problems. That a question mark signifies a ‘help function’ on a web-page is arbitrary; it could have just as easily been a different icon.

The context of CSCL, as are all learning environments, is a unique combination of the technological, the social, and the educational context. Take, for example, figures 3a and b. Both represent learning situations, but the contexts in the two are completely different along all three dimensions. The educational contexts are different (competitive versus collaborative), the social contexts are different (individual versus group), and the technological (physical) contexts are different (individual workspaces with minimal assortment of materials versus group workspace with a rich assortment of materials).

In CSCL, the educational context is one of collaborative learning, the social context is the group, and the technological context is a computer-mediated one. At the Open University of the Netherlands, for example, it is a computer-mediated communication environment where the lowest common user denominator determines the choices. The educational context is competence-based learning grounded in social constructivism. The social context is one of minimal direct contact, maximal guided individual study, and primarily asynchronous, text based contact (e-mail, discussion lists, and electronic learning environments). Other institutions have other priorities.
When technology mediates the social and educational contexts we speak of ‘technology affording learning and education’. Therefore, we may distinguish between three types of affordances - educational, social, and technological - which will be described in the next sections.

4.1 Educational Affordances

Kirschner (2002) defines educational affordances as those characteristics of an artefact (e.g., how a chosen educational paradigm is implemented) that determine if and how a particular learning behaviour could possibly be enacted within a given context (e.g., project team, distributed learning community). They are the
relationships between the properties of an educational intervention and the characteristics of the learner (for CSCL: learner and learning group) that enable particular kinds of learning by him/her (for CSCL: members of the group too).

Educational affordances in distributed learning groups encompass the same two relationships that all affordances must meet. First, there must be a reciprocal relationship between group members and a CSCL environment. This means that, on the one hand, the environment must fulfil the educational/learning intentions of members as soon as these intentions crop up. On the other hand, the educational affordances must be meaningful and support/anticipate those intentions as soon as they crop up. Second, there must be a perception-action coupling. Once a learning need becomes salient (perception), the educational affordances will not only invite but will also guide her/him to make use of a learning intervention to satisfy that need (action). The salience of the learning intervention may depend upon factors such as expectations, prior experiences, and/or focus of attention.

4.2 Social Affordances

Kreijns, Kirschner, and Jochems (2002) define social affordances as the “properties of a CSCL environment that act as social-contextual facilitators relevant for the learner’s social interaction.” (p. 13). Objects that are part of the environment can realise these properties; hence they are designated social affordance devices. When social affordances are perceptible, they invite learners to engage in activities that are in accordance with these affordances, i.e., there is social interaction. Very similar is the definition posited by Bradner, Kellogg, and Erickson (1999) who define a social affordance as “the relationship between the properties of an object and the social characteristics of a group that enable particular kinds of interaction among members of that group.” (p. 153). The physical world is a rich and very social space. Although a hallway in an office complex affords little interaction (except for people passing in them), if the doors are open or if the area next to the door is fitted with glass, then the hallway now affords more awareness of and contact between employees. This awareness, in turn, brings social rules that govern actions into play. When someone is busy, it is considered rude to interrupt her/him. Bradner et al. (1999) chalk this up to accountability: I will not just barge into your room because I know that you know that I know that you are busy, and therefore I will be held accountable for my actions.

In the ‘physical’ world, affordances abound for casual and inadvertent interactions. In the ‘virtual’ world, social affordances must be planned and must encompass two relationships. First, there must be a reciprocal relationship between group members and the CSCL environment. The environment must fulfil the social intentions of members as soon as these intentions crop up while the social affordances must be meaningful and support or anticipate those social intentions. Second, there must be a perception-action coupling. Once a group-member becomes salient (perception), the social affordances will not only invite, but will also guide another member to initiate a communication episode (action) with the salient member. Salience depends upon factors such as expectations, focus of attention,
and/or current context of the fellow member. ICQ® (pronounced ‘I-Seek-You’) and MSN Messenger® are online instant messaging programs that can be seen as basic social affordances for CSCL-environments.

4.3 Technological affordances

According to Norman (1988) affordances are the perceived and actual properties of a thing, primarily those fundamental properties that determine how the thing could possibly be used. Some door handles, for example, look like they should be pulled. Their shape leads our brains to believe that is the best way to use them. Other handles look like they should be pushed, a feature often indicated by a bar spanning the width of the door or even a flat plate on the side. Others, and here is the problem, do not present a clue. Norman (1988), thus, related affordances to the design aspects of an object suggesting how it should be used. He links affordances to an object’s usability, and thus these affordances are designated technological/technology affordances (Gaver, 1991). Technology affordances offer a framework from which all the aspects affecting usability can be studied. As Gaver (1991) put it, “the notion of affordances is appealing in its direct approach towards the factors of perception and action that make interfaces easy to learn and use. “More generally, considering affordances explicitly in design may help suggest ways to improve the usability of new artifacts.” (p. 83).

4.4 Affordances and Useful CSCL-Environments

Jacob Nielsen (1994) distinguished between utility and usability. Utility has to do with the functionality that a system offers to the user. A system that is usable but does not have the functionalities to support the user in what (s)he wants to accomplish is, de facto, worthless. Nielsen (1994) defined usefulness to be utility plus usability. In CSCL environments the utility is determined by both its educational and social functionality (see figure 4).

![Figure 4. Usefulness is determined by various types of affordances.](image-url)
In addition, because social functionality is incorporated in the CSCL environment, this environment is designated to be a sociable CSCL environment. From the previous sections we make a plea for designing and implementing educational and social functionalities from the perspective of educational and social affordances, and that usability matters should be resolved from the perspective of technology affordances. Only then can useful CSCL environments be created.

5. A DESIGN FRAMEWORK BASED UPON AFFORDANCES

The framework that is outlined in the following sections consists of two levels: a general level and a specific level. The general level consists of a six-stage model for the design of efficient, effective and satisfying CSCL environments. This six-stage model (Kirschner, 2002; Kirschner, Strijbos, & Kreijns, 2003) is shown in Figure 5.

![Figure 5. Six-stage model of educational design.](image)

In this model, the designer must:

1. **Determine what learners actually do**: Watch students interact, observe groups interacting to solve problems, observe users interacting with software, et cetera, and do this before designing and developing. Step back from your natural propensity as designer to believe that you either ‘represent the average user’ or that you ‘know what is best for him/her’.

2. **Determine what can be done to support those learners**: Determine, based on stage one, what actually needs to be supported/afforded, and then proceed.

3. **Determine the given constraints and conventions prior to determining which designed constraints can support the group of learners**: Look further than the technological constraints and conventions and take into account the educational
and social constraints and conventions that play a role. Learners are products of their educational experience and, as such, are used to certain types of education and have been socialised to study, learn and act in specific ways. Denying or neglecting these given constraints will guarantee failure, both of the environment and the learning. Next determine, using the specific design level, which designed constraints can be provided to support the interacting students.

4. *Determine how learners perceive and experience the support provided:* There is a world of difference between (good) intentions and user perceptions thereof. Research and design must be carried out as iterative, interacting processes. New ‘products’ must be tried out with intended users at stages in their development where physical and conceptual changes can still be made. In this way not only is the usefulness assured, but also the usability.

5. *Determine how the learner actually uses the support provided:* Analogous to stage one, and following up the more formative evaluations carried out in stage four, determine if the learner actually does what is hoped or expected.

6. *Determine what has been learnt:* The goal of education is learning and there are three standards to determine the success of any instructional design, namely its effectiveness, its efficiency and the satisfaction of those learning (and also those teaching). An increase in one or more of the standards without a concomitant decrease in any of the others means success. This is the proof of the pudding.

These six stages provide a general approach to designing CSCL settings. A design, however, must also ensure that the type of interaction thought to be supportive for competency development genuinely occurs. Thus, complementary to the six-stage model, a more specific methodology is needed which supplies the designer with those questions that must be answered in order to determine the designed constraints in a CSCL environment. Strijbos, Martens and Jochems (in press) state that the design of CSCL is often based on subjective decisions regarding tasks, pedagogy and technology, or often confusing or confused concepts such as ‘cooperative learning’ and ‘collaborative learning’. What is needed is a much clearer elicitation of expected interaction processes. Process-oriented methods may stimulate designers to adopt a probabilistic approach to CSCL design according to the expected interaction, paying attention to critical elements affecting the interaction. They propose six steps for determining the designed constraints:

1. Determine the type of learning objective to be achieved.
2. Determine the expected interaction.
3. Select the task-type with respect to the learning objective and the expected interaction.
4. Determine whether structure is necessary, and if so to what extent it is necessary, with respect to the learning objective, expected interaction and the task-type.
5. Determine the group size best suited to the learning objective, expected interaction, task type and level of pre-structuring.
6. Determine how computer support is best used to support learning and expected interaction.
Space does not allow a comprehensive operationalisation of the two frameworks for the whole of the educational process and all of the actors taking part in it. Since most educational design centres around the task, we have chosen to focus the operationalisation of the framework on this key issue. In stage three of the general approach, namely that of determining the limitations to learning imposed by the learning environment we identify three task-constraints that need to be considered, namely task ownership, task character and task control (see Figure 6).

![Diagram of task ownership, character, and control](image)

**Figure 6. Three dimensions of educational tasks.**

6. TASKS

The remainder of this chapter discusses these three dimensions. We regard task ownership, task character, and task control as crucial elements in the educational affording of CSCL. These elements will be illustrated through prototypical design questions that need to be considered at the specific level for determining the design constraints. These questions are derived from the six-step methodology developed by Strijbos et al. (in press). An overview of all the design questions is provided in Figure 7 (at the end of this section).

6.1 Task ownership

Both teacher and learner play important roles in the educational and/or learning process. Neither has a monopoly on what is good for learning, but the decision as to
who ‘owns’ the task can lead to fundamental differences in what is learnt and how it is learnt. Task ownership is basically a question of who determines or is responsible for determining what each of the participants in a collaborative learning environment must do and who provides the (social) steering?

In this respect, the designer needs to deal with issues such as the distribution of roles and responsibilities for learning in the environment. The choices made, for example, can determine whether all team members carry out the exact same actions, and thus all learn the same things and acquire the same skills or whether each member has specific tasks and responsibilities and thus that the team members carry out different, interdependent actions and possibly learn different things and acquire different skills. In the former, the breadth of the ‘product’ of collaboration might be large, but in the latter - through division of labour - the depth will possibly be much greater.

A second design decision directly related to task ownership relates to whether or not (pre)structuring is necessary and the extent to which it is prescribed. High levels of structuring are often highly efficient, leading to the acquisition of more closed learning such as procedural and conceptual learning whereas lower levels of structuring are less efficient, but by allowing more freedom to discuss and negotiate multiple perspectives allows for deeper, dialogic learning. External structuring (by the teacher) often focuses on mastery of specific learning materials while internal structuring (by the learners themselves) often stimulates information search and retrieval and the necessary evaluation skills for determining quality and relevance.

In traditional education the institution is the owner, manifesting itself in a ‘didactic’ approach that emphasises individual acquisition of knowledge and skills. This approach has worked for years; it has been handed down from generation to generation and is very difficult to change. This approach is visible in many CSCL environments that emphasise the knowledge and skills that each group member individually must attain (Johnson, Johnson, & Johnson-Holubec, 1992; Slavin, 1997). One could convincingly argue that such implementation is paradoxical, contradictory and counter-productive. This paradox is exacerbated by their use of competitive assessment methods (Kirschner, 2000; see also Chapter 4 by Chan & van Aalst, this volume).

At the other end of the continuum are competency-based environments where it is not the individual acquisition and application of knowledge and skills that is most important, but rather the performance of each individual in and with the rest of the group. Environments that stress and reward individual initiative, that are open to influences from the students and where the students themselves are owners of the learning problem are found here. The need for a feeling of ownership is based upon two pedagogical principles considered to be highly beneficial to learning/working in teams, namely individual accountability and positive interdependence.

Individual accountability (Slavin, 1980; 1997), as a concept, was introduced to counter a number of deleterious effects of working together in groups. The free-rider or hitchhiking effect exists when group members exert less effort as the perceived dispensability of their efforts for the group success increases (Kerr & Bruun, 1983). In other words, they feel that the group is doing enough and that they do not have to contribute. Social loafing (Latané, Williams, & Harkins, 1979) exists
when group members exert less effort as the perceived salience of their efforts for the group success decreases. In other words, as the group size increases so does the anonymity and the non-participation. Finally, the *sucker effect* (Kerr, 1983) exists when the more productive group members exert less effort as the awareness of co-members free-riding increases. Those group members refuse to support non-contributing members further (they refuse to be ‘suckers’) and therefore reduce their individual efforts.

By allowing for and even stressing individual accountability, what the group does as a whole does not become less important, but the individual contribution becomes more important. In this group environment, each group member is held individually accountable for his or her own work. For example, in many problem-based learning environments students’ sense of individual ownership is increased by *also* grading them for their individual effort, irrespective of the group performance.

*Positive interdependence* (Johnson, 1981) reflects the level to which group members are dependent upon each other for effective group performance (enhanced intra-group interaction). The concept holds that each individual can be held individually responsible for the work of the group and that the group as a whole is responsible for the learning of each of the individual group members. Group members are linked to each other in such a way that each group member cannot succeed unless the others succeed; each member’s work benefits the others (and vice versa). Positive interdependence is evident when group members in a project-centred learning environment carry out different tasks, all of which are needed in the final product. This interdependence can be stimulated through the task, resources, goals, rewards, roles or the environment itself (Brush, 1998). In other words, individual accountability and positive interdependence counter the tendency towards hiding and anonymity. In situations requiring such interdependence, students learn more than when this is not the case (Lou, Abrami, & d’Apollonia, 2001). Positive interdependence, in turn, provides the context within which *promotive interaction* takes place. According to Johnson and Johnson (1996), promotive interaction “exists when individuals encourage and facilitate each other’s efforts to complete tasks in order to reach the group’s goals.” (p. 1028).

In collaborative environments, educators often make use of specific techniques or technologies that structure a task-specific learning activity (see the Chapter 5 by Järvelä, Häkkinen, Leinonen and Arvaja, this volume, on instructional support; and Chapter 6 by Jermann, Soller and Lesgold, this volume, on computer software support). Examples of such instructional techniques are Student Teams Achievement Divisions (Slavin, 1986), Jigsaw (Aronson, Blaney, Stephan, Sikes, & Snapp, 1978; Slavin, 1990) and Structured Academic Controversy (Johnson & Johnson, 1993), which not only guide collaboration but also teacher-student interaction (see Chapter 7 by Lund, this volume, for an overview of human support).

Finally, the perception of ownership tends to (intrinsically) motivate students to carry out a task/do an activity because they want to, not because they have to (e.g., self-determination theory; Deci & Ryan, 1985; Ryan & Deci, 2000). This theory posits that people will be most likely to act to produce change if they are doing so for intrinsic or personal reasons, that is, their motivation is to change for themselves, not by pressure from outside or extrinsic forces.
6.2 Task character

Constructivism holds that knowing is an active, adaptive process involving the person learning and the context in which (s)he learns (Brown, Collins, & Duguid, 1989). Learners assimilate new concepts into already available cognitive structures (schemas - ultimately the result of prior experiences and prior learning) and the schemas are in turn adapted to accommodate new interpretations of experiences (Von Glasersfeld, 1988; see also Chapter 3 by Stahl, this volume). Knowing and doing cannot be separated, and as such, the character of a task (the 'doing' component) is of the utmost importance for learning (the ‘knowing’ component) regardless of whether learning is collaborative.

In this respect, the designer needs to deal with issues such as the relationship between the objectives of the tasks and the types of interaction that are required to carry out the tasks. Questions arising out the choice of objectives and their relationship to the tasks relate to the level of structure or clarity of the task itself. Is the task or problem well-defined, ill-defined, or even wicked in nature? Interaction questions that arise are, for example: Does this interaction focus on the exchange of facts, or ideas, or techniques, or all three? Is the interaction focused on exchange of information or the negotiation of the meaning of the information? Is this all clear-cut so that the process is clear or do these interactions themselves need to be coordinated?

Traditional school tasks are highly constructed, well-structured, well-defined, and short. They are oriented towards the individual, and designed to best fit the content to be taught instead of reality. Archetypal problems are, for example: “Two trains travelling in opposite directions at a speed of ... How long ...”. Such tasks, though often seen as highly suitable for acquiring individual skills, are not representative for the type of problems that are perceived as relevant by the student, nor have they been proven to be especially effective for achieving transfer or for acquiring complex skills and competencies. This is the case for both group and individual learning.

At the other end of the spectrum are ‘real life’ (authentic) problems that are almost always ill-structured (Mitroff, Mason, & Bonoma, 1976) and/or wicked (Conklin & Weil, 1997; Rittel & Webber, 1973/1984). They are often so complex and multifaceted that only multidisciplinary groups can adequately solve them, where group members assuage cognitive conflict, elaborate on each other’s contributions and co-construct shared representations and meaning.

A complicating factor here, however, is that authenticity itself is variable; it is not always clear to whom and to what extent an authentic task really is ‘authentic’. Is a task authentic when students have to play a role with which they have no affinity or if they are not familiar with the actual practice such as when a freshman has to play the role of bank manager? Is the problem that needs to be solved really ‘our’ problem or rather ‘yours, hers or theirs’?

Whatever the case, such problems require a different educational approach than do simple, well-defined ones. Learning to solve problems involves acquiring complex cognitive skills and competencies, which in turn requires making use of meaningful whole tasks (Van Merriënboer, 1997), since real-life tasks, after all,
never come in neatly constructed segments of some idealised whole. These tasks, however, then need to be divided into non-trivial, authentic part-tasks because the full complexity of real-life tasks typically interferes with effort-demanding inductive processing (Nadolski, Kirschner, Van Merriënboer, & Hummel, 2001). In a collaborative situation these part-tasks often aim at achieving epistemic fluency: “(...) the ability to identify and use different ways of knowing, to understand their different forms of expression and evaluation, and to take the perspective of others who are operating within a different epistemic framework.” (Morrison & Collins, 1996, p. 109). Ohlsson (1995) enumerates seven epistemic tasks that can be used in the design of collaborative environments namely describing, explaining, predicting, arguing, critiquing, explicating, and defining.

These types of tasks (task classes) are archetypical for competence-based learning to achieve what Honebein (1996) calls the ‘pedagogical goals’ of constructivist learning environments, namely knowledge construction, appreciation of multiple perspectives, relevant contexts, ownership of the learning process, social experience, use of multiple representations, and self-consciousness/reflection.

6.3 Task control

Task control relates to the shift of control from the educational institution or system (often personified by the teacher) to the learner with respect to the path, events and/or flow of instruction and learning. This final continuum runs from complete institutional control of what, when and how things are taught to complete learner control where learners actively define and negotiate learning tasks (the heart of constructivist learning). For a discussion of the tension between institutional objectives and learner control with respect to CSCL technology, see Chapter 8 by De Graaff, De Laat and Scheltinga, this volume. Although the idea of this shift of control can be traced back to Dewey, it came to maturity in the last quarter of the twentieth century with psychology’s flirtation with aptitude-treatment-interactions (ATI: Cronbach & Snow, 1981) and the emergence of instructional design theories. From the ATI side, learner-controlled instruction is seen as instructional events or tactics that increase learner involvement, mental investment, and achievement. Learners are free to choose learning activities that suit their own individual preferences and needs. They tailor their instruction to their own style of learning, leading to more efficient and effective learning and higher motivation. On the instructional design side, Merrill (1983), for example, prescribes learner control of content (encompassing curriculum, lesson, and module selection) and of strategy (spanning various forms of presentation). He (1987) contends that when this is the case, learners themselves arrive at self-determined instructional strategies that are optimal, when given an opportunity to exercise choice over them. This, in turn, should lead to increased opportunities for self-assessment and reflection; increased self-regulation.

In this respect, the designer needs to deal with issues such as who actually determines the structure of the interaction and its coordination. Do learners take responsibility for interaction and group performance or are the individual students
only responsible for their own actions and performance. A second major issue relates to the choices surrounding group size and makeup. Finally, the designer needs to decide as to the degrees of freedom allowed to the learners to even determine what is to be learnt.

Task control is strongly related to ‘learner control’. In its broadest sense, learner control is the degree to which a learner can direct his/her own learning experience (Shyu & Brown, 1992). Instead of being the object of a lesson, the student is placed in a position of importance and control. More specifically, learner control (Hannafin, 1984) is the degree to which learners control what is learned, the pace of learning, the direction learning should take, and the styles and strategies of learning that are to be adopted. This list can (and should) be expanded to include control over the choice of methods and timing of assessment.

Conventional wisdom says that the more the learner controls his/her own instruction, the more rewarding the experience will be. Ross and Morrison (1989) noted that the idea that learners can be given control of their own learning is rooted in two assumptions namely: learners know what is best for them and learners are capable of acting appropriately on that knowledge. The debate is epitomised in that some have argued that discovering information on one’s own is the best way to learn (e.g., Bruner), while others stress structure and direction as the important ingredients in the promotion of student learning (e.g., Ausubel). This debate has also surfaced in the fields of computer-based instruction and intelligent tutoring systems. Kinzie, Sullivan, and Berdel (1988) found that by transferring the locus of control from the teacher to the student, intrinsic motivation to learn increased and more satisfaction was derived from the learning experience, ultimately leading to improved academic performance.

This has been backed up by other researchers who have determined learner control to be an essential aspect of effective learning (Kohn, 1993; Lawless & Brown, 1997; Lou, Abrami, & d’Apollonia, 2001). Research findings in this direction are in accordance with the application of cognitive evaluation and over justification theories.

“Cognitive evaluation theory emphasizes the controlling aspect of performance-contingent rewards in reducing personal autonomy or self-determination. The loss of perceived autonomy leads to a loss of intrinsic motivation. Over justification theory emphasizes the shift in attribution from internal to external sources that performance-contingent rewards produce. Both accounts predict that performance-contingent rewards are detrimental to intrinsic motivation to children for reading” (Cameron, Banko, & Pierce, 2001, p. 26).

With respect to learning tasks, by giving learners control they gain the opportunity to determine many aspects of their learning such as depth of study, range of content, and time spent on learning. With these options, learners can tailor the learning experience to meet their specific needs and interests. They are more autonomous, ask more questions, and participate in more conceptually based information exchanges than students in traditional classrooms due to an increase in perceived meaningfulness, self-assessment, and motivation (Kinzie & Sullivan, 1989) and increased feelings of competence, self-determination and intrinsic interest (Lawless & Brown, 1997).
On the other hand, there is also a large body of research (for an excellent review, see Williams, 1996) that shows that not all learners prefer or profit from controlling the tasks (Carrier, 1984; Millheim & Martin, 1991), and that forcing such control on them can be mathemathantic (Snow, 1980; Rasmussen & Davidson-Shivers, 1998). This is because students generally do not make good use of learner control options, a position taken by Carrier (1984). The reason for this is that learners apparently do not have or do not know how to utilise appropriate strategies when they are left to themselves to manage their learning environment, i.e. they may not have the capacity to appraise both the demands of the task and their own learning needs in relation to that task in order to select appropriate instruction.

Snow (1980), a pioneer in Aptitude Treatment Interaction research argues that far from eliminating the effects of individual differences on learning, providing learner control may actually exacerbate the differences. Rasmussen and Davidson-Shivers (1998), for example, found that active learners preferred lower levels of learner control and performed best in structures that were highly controlled by others. Reflective learners, on the other hand, perform best when learner control options are available. In other words, one level of control does not fit all learners. High levels of learner control may prove counterproductive when applied to some learners.

Finally, Plowman, Luckin, Laurillard, Stratford, and Taylor (1999) contend that from the student’s point of view teacher-controlled CSCL is a question of guidance while student-controlled learning is more one of construction. Nevertheless, the context of CSCL provides the opportunity to expand learner control, using technical tools to increase awareness of other group members input in the group performance (see also Chapter 9 by Kreijns and Kirschner, this volume).

Summing up, we present a ‘checklist’ of prototypical design questions that educators need to consider for determining the constraints for designing, developing and implementing CSCL environments at the specific level (see Figure 7). Taking heed of these questions will not guarantee a perfectly functioning CSCL environment, but neglecting them will almost surely lead to a poorly functioning one.

7. CONCLUSIONS

The vocationalist and reflexive views on competency development (Goodyear, 1998), underline a clear demand for collaboration in higher education. However, multiple collaborative environments exist. We have outlined a theoretical framework to aid researchers and practitioners in their design of collaborative learning/CSCL settings. The concept of educational affordances is central to this framework.

With respect to the design of CSCL, learning is no longer causal or deterministic, but has become probabilistic. A point of primary importance is whether the elements of a learning environment afford the type of competency development that was targeted. With respect to collaboration, the question is whether the elements of the environment afford the emergence of that type of social interaction that is supportive of the acquisition of the targeted skill.
1. Determine which type learning objective will be taught:
   - What type of skills will be taught?
   - Are all students required to learn the same skill(s)?
   - Must all individual students display mastery of the learning objectives?

2. Determine the expected interaction:
   - Will the interaction focus on feedback (comment draft/final version)?
   - Will the interaction focus on exchange of (creating) ideas (findings)?
   - Will the interaction focus on discussion, argumentation of multiple alternatives/opinions?
   - Does interaction require co-ordination of activities whilst solving a complex problem?
   - Does interaction require a collaboratively written report representing shared understanding?

3. Select task-type with respect to the learning objective and expected interaction:
   - Which task-type is best suited for teaching the selected skills?
   - Are all students required to study the same material?
   - Will they have to solve a complex and ambiguous problem with no clear solution?
   - Will the chosen learning objectives and task-type require communication?
   - Will the chosen learning objectives and task-type require coordination?

4. Determine whether and how much structure is necessary with respect to learning objective, expected interaction and task-type:
   - Determine to what extent the group interaction processes will be pre-structured in advance?
   - Are students each assigned to a portion of the material?
   - Are students each assigned individual responsibilities for interaction and group performance?
   - Are students dependent on each other during the whole course or only a part of the course?
   - How will the students be graded: individual test-scores, one group-score for the groups’ performance, individual-score for each member’s participation and contribution, or a combination?

5. Determine which group size is best suited with respect to learning objective, expected interaction, task type and level of pre-structuring:
   - Is interaction with other group members obligatory or optional?
   - Is there a set minimum for group interaction participation?
   - Is the effort of all group members needed to achieve the objectives?
   - Does the interaction focus on feedback (dyads), idea generation (large group: 7 or more) or consensus generation and negotiation (small group: 3 to 6)?
   - Will all members have to contribute equally?
   - Is there a need for diversity in opinion (discussion) or is there a focus on exchange of ideas (feedback)?

6. Determine how computer support is best used to support learning and expected interaction:
   - How will students ‘collaborate’ at a computer or via computers?
   - Is communication face-to-face, computer-mediated or a combination?
   - Interaction: same time/same place (face-to-face: with and at computer)?
   - Interaction: same time/different place (synchronous CSCL)?
   - Interaction different time/different place (asynchronous CSCL)?
   - What support is required: file sharing, communication, a combination?
   - Which tool (newsgroup, groupware or chat) supports the setting best?

Figure 7. Prototypical design questions to determine the designed constraints of a CSCL setting (see Strijbos et al., in press).
These questions cannot be easily answered. We, as designers, often think we know what our designs and products will do, and how the people for whom our designs and products are intended will use them. Unfortunately, this is not always the case. Each of the phases in the design process needs to be studied with respect to the specific choices that can and must be made.

The design of CSCL needs to be carried out at two levels, namely a generic and a specific level. The impacts of both levels have been illustrated with respect to task ownership, task character and task control. Clearly, the design of CSCL requires that both levels be taken into account, with the specific level being a detailed depiction of the third stage of the general model in that it is used to determine the constraints of the learning environment.

Although teachers and designers may prefer a clear set of design rules (i.e., first do A, then do B if you want to achieve C), a deterministic checklist with a limited number of categories is one step too far. We have, however, provided a number of specific design questions to stimulate teachers and designers to think more deeply about their instructional decisions and not simply rely on their traditional approach that ‘has always worked so well’.

8. REFERENCES


CSCL IN HIGHER EDUCATION?


