Three worlds of CSCL: Can we support CSCL?

Inaugural Address

Can we support CCSL? Educational, social and technological affordances for learning

Paul A. Kirschner, Open Universiteit Nederland

Symposium

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For Catherine, Femke, Jesse, Mara and Aron -
You afford my life

With few exceptions the solitary animal is, in any species, an abnormal creature …The dominant principle of social life is not the struggle for existence, but cooperation … If we would seek for one word that describes society better than any other…The word is COOPERATION.
Ashley Montagu[1] (1905-1999)

The only place where people are asked to work alone in a competitive atmosphere on a regular basis is the college classroom.
D. Schumaker[2] (1989)

I'm proud that we learned so much from ourselves. I didn't know we knew anything about this subject.
Tom and Ray Magliozzi, CarTalk®

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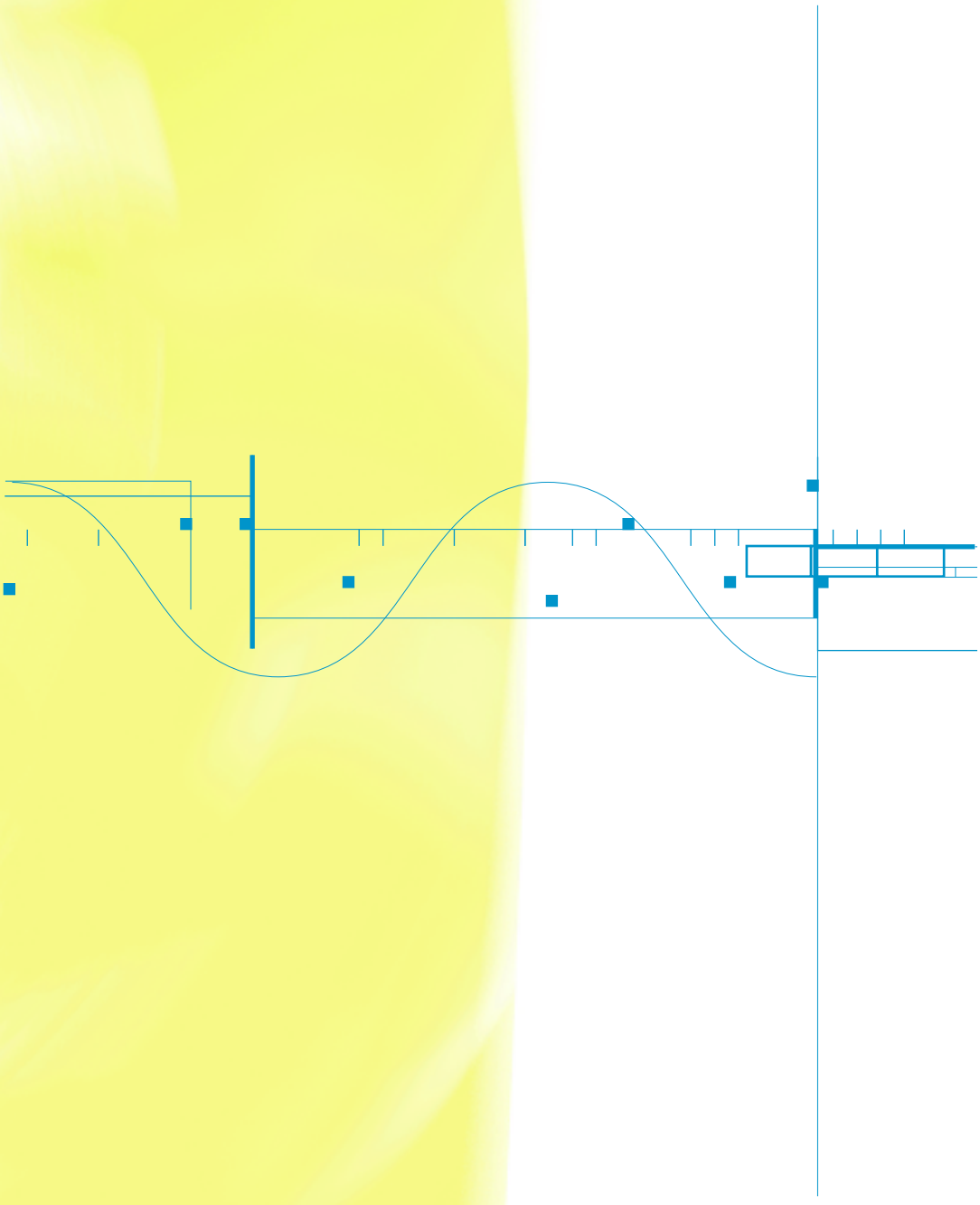


Can we support CSCL? Educational, social and technological affordances for learning

Inaugural Address

spoken upon the public acceptance of
the professorship in Educational Technology,
in particular Computer Supported Collaborative Learning
at the Open Universiteit Nederland
on Friday, October 25, 2002

by prof. dr. Paul A. Kirschner

Mister chancellor and vice-chancellor,
Colleagues and invited guests,
Family and friends,
Ladies and gentlemen,

Behold, a doorknob!

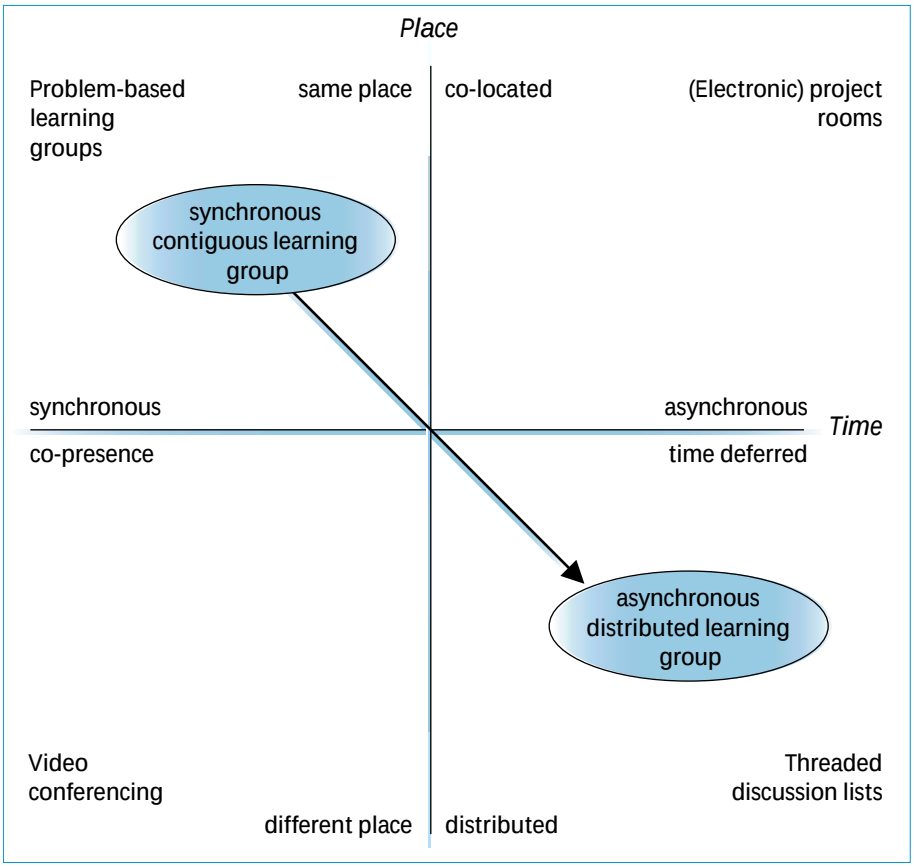
You look at this object and probably conclude that it should be grasped and turned, and either pulled or pushed. A cognitive psychologist would say that you know this thanks to pattern matching and scripts. Pattern matching entails having schemas of all different types of objects somewhere in your brain and matching what you see with what you 'know'. You determine that it is not only a doorknob, but also a doorknob of a certain type namely one that also contains a lock. Having successfully done the matching, you then search for a script stored somewhere in your memory which tells you that for this specific doorknob you use the specific script: grab and turn. A similar object initiates similar processes.

Ecological psychologists look at this differently. They see the object itself as having certain properties, which 'tell' you what to do. In other words, there is a relationship between an actor (you) and the world (the knob). In this way of thinking, this door knob has grab and turn properties on a door with either push or pull properties for an actor with an opposable thumb (to grab; hominoids), a flexible wrist (to turn; an arthritis sufferer doesn't have this) and sufficient mass (to pull or push).

These characteristics of an object are known as affordances and properly exploiting them is - in essence - taking care that these affordances are perceived and used.

What's it all about?

At the time of this writing, the communal opinion in education land appears to be that collaborative[3] learning is the golden key to the future. Computer supported collaborative learning (CSCL) environments[4] are seen as tools that permit educators to latch on to current constructivist insights in teaching and learning that rely heavily on collaborative learning, encompassing dialogue and social interaction amongst the group members and that allow learners and instructors to be geographically dispersed, thus relaxing the need to be co-located for meetings and discussions. In addition, learners can often engage in learning at any time, dismissing necessity for co-presence. This 'anywhere-anytime' characteristic enables a shift from real-time contiguous learning groups to asynchronous distributed learning groups, something especially interesting for distance learning institutions. This shift is depicted in the following figure.



Despite this potential, research on the use and effectiveness of CSCL environments is inconclusive. Researchers, educators and designers have reported positive (Brandon & Hollingshead, 1999) and negative outcomes. The negative outcomes are predominantly based on low participation rates and/or varying degrees of disappointing collaboration. For example, Hallett and Cummings (1997) observed: "By having the majority of assignments in public forums with the entire class posting at a given time, and with numerous prompts and encouragement from the instructor, it was hoped that interaction among students would occur naturally. This was not what took place" (p. 105). Fischer, Bruhn, Gräsel, and Mandl (2002) report that "an array of studies … has shown that efficient learning rarely is achieved solely by bringing learners together" (p. 216). Generally, low learning performances in terms of quality of learning and learner satisfaction in CSCL environments are the consequences. Gunawardena (1995) explains the negative experiences from her observations in computer conferences where "the social interactions tend to be unusually complex because of the necessity to mediate group activity in a text based environment. Failures tend to occur at the social level far more than they do at the technical level" (p. 148). Hobaugh (1997)

emphasizes that in distributed group learning, problems with social dynamics amongst group members are often the major cause of ineffective group actions. In other words, all the more reason to take a closer look at the social and social psychological aspects of collaborative learning in (a)synchronous distributed groups and how they can be supported.

The subject of this address is the conditions under which computer supported collaborative learning can lead to knowledge sharing and knowledge building and what the Educational Technology Expertise Center at the Open University of the Netherlands is and will be doing to help achieve this. It deals with this from two sides that are connected to each other by the word AFFORDANCES.

Affordances

Let's go back to the door knob. Short and sweet, affordances are the perceived properties of a thing in reference to a user that influences how it is used. Some door handles 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.

Originally proposed by James Gibson in 1977 (and refined in 1979), the term affordance refers to the relationship between an object's physical properties (artifacts) and the characteristics of an agent (user) that enables particular interactions between agent and object[5]. Gibson defined that "the affordance of anything is a specific combination of the properties of its substance and its surfaces with reference to an animal" (Gibson, 1977, p. 67). A pond, due to the surface tension of the water, affords a surface to walk on for certain species of flies while also affording a living environment for certain types of fish. Knobs are for turning and slots are for inserting things. These properties/artifacts interact with potential users and provide strong clues as to their operation (think of your child, his/her peanut butter sandwich and the slot in your video recorder!). 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[6]. The concept of affordances, in the sense proposed by Norman, has proven a very useful, though often, misunderstood, misrepresented, and misused[7] concept for understanding how design and perception have an impact on technology design and use, and could be useful in explaining GroupWare adoption[8]. Using this concept of affordances in CSCL-environments requires a number of reasoning steps which I will now set out in terms of four premises.

The reader must not take the original meaning of affordance for an artifact as complicated as a CSCL environment literally. Affordances in Gibson's sense apply primarily to very simple artifacts where a direct 'see-do coupling' exists. The actor doesn't consciously think, but rather perceives the affordance and acts, although the ability to perceive the affordance (discriminate patterns of information in order to be able to perceive something) may need to be learnt.
For complicated artifacts such as educational environments, learning must also be considered and is permitted. There is a perception-action coupling, but it is less direct. After a learning/habituation period, the actions become automatic and unconscious. Affordances in this sense don't cause, but merely allow. They lower the threshold for carrying out and/or permit an action.

Four premises

Premise 1: It is not only the properties of a medium that affect how they can be/are used, but also how (and if) they are perceived and the relationships that exist between the properties and the use(r).

Examples:

- In an office hallway, vertical, see-through glass windows next to the door allow you to see if the light is on (indicating possible presence), if the occupant is actually present, if the person is busy working, and thus whether it is opportune to enter the room.
- Email allows CSCL-users to communicate. But not all email is the same. Email via broadband to individual computers makes continuous connection, quick response, and sending and receiving large attachments possible. Email via modem to a central computer necessitates sporadic use, slow response, and small attachments the order of the day.

Both examples show the technological affordances present in the objects (hall/email), but there is more. The fact that the windows need to be at least translucent, that the height and placement of the windows must allow looking through them and that good manners dictate that we don't interrupt someone talking to another person also determine whether certain behaviors can be/are afforded. Broadband connection allows us to use email in an instantaneous way and informs us that an immediate response means that the addressee is probably at his/her desk moment.

Although every object has specific affordances, what we as educational researchers and designers are actually dealing with are not the affordances themselves, but rather the combination of the perceptible (Gaver, 1966) 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[9]. These perceived affordances are limited by physical (you can't see through opaque glass), logical (you don't put a window on the bottom of a door), and cultural (you don't put a window in a toilet door) constraints and cultural conventions (you don't 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[10] 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 doesn't 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*[11] 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 symbolize grabbing the text. Such conventions prohibit some activities while encouraging others.

Conventions - according to Norman - are *arbitrary*[12] 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. An example of violating this convention is well known to Open University staff and students. The symbol set on its web site violates conventions with respect to the search- and help functions and makes usage for those who are not in 'the in crowd' unclear and difficult.

Premise 2: Behavior is embedded in and shaped by its (cultural and material) context.

Hofstede (1997) noted that distinct cultural diversity can exist between nearby national cultures. One doesn't have to look very far to see this. Within the Netherlands, a miniscule country by most standards, there are enormous cultural differences between the sober Groninger, the brash Amsterdammer and the Bourgondian Limburger. These differences manifest themselves in social behaviors which influence relationships, habits, and beliefs. In other words, social behavior is embedded in a group's particular cultural context and is guided by deeply held values and beliefs. Ignoring or abusing these differences can bring about social failures and cause otherwise good things to go wrong (Hoecklin, 1994).
In education, and especially in distributed learning groups, Hofstede's (1980) ideas on factors determining diversity take on special importance. He describes four dimensions by which (national) cultures vary, namely power distance, uncertainty avoidance, collectivism-individualism, and masculinity-femininity[13]. In distributed learning, Granger[14] (1995) points out that Hofstede's ideas on diversity influence factors as knowledge, prior skills, (implicit) language, learning patterns and styles, and learning goals and motivations.

But behavior is not only embedded in and shaped by cultural context, it is also embedded in and shaped by material context. Take the following two dining areas.

Both tables, except for their size (and thus the number of places) afford the exact same things. The difference is that the top figure depicts a table in an elegant dining room for a formal meal while the lower depicts a table in a cozy dining room for a 'family dinner'. The way we behave at the top table will probably be quite different from the way we behave at the bottom one. The affordances are the same, but the material contexts are different and so are the social behaviors that will be exhibited[15]. This is also true for the earlier described email contexts.

Examples:

- Discussions in a meeting context are quite formal and regulated. Participants are formally invited to attend which begin and end at a certain time and follow a set structure. There are often roles (both explicit and implicit) for the different participants and there are many spoken and unspoken rules of decorum.
  Discussions in a party context are informal and occur between people in close physical proximity. The structure changes quite often (as do the subjects discussed) without any fixed, predetermined order. The roles of the participants also change quickly depending upon who enters the discussion at any moment. Finally, although there are also rules of decorum at a party, they are quite different from those at a formal meeting.
- Face-to-face collaboration is dominated by social presence (a sense of being together) where individuals can effortlessly interact. They not only work on a task, but also sense each other (smell, see, touch), share non-task activities (eat, drink, small talk) and manage their and each other's attention - activities all crucial for sustaining the social relationships that make distributed work possible.
  Distributed collaboration supported by computer mediated communication (CMC) systems16 is weak in social presence. The user feels alone most of the time (a sense of isolation), often not knowing who else is busy at any given time. Users work on their own task, sometimes on a previous concept of a (partial) solution proposed by another though not knowing if someone else is doing the same thing at the same time. There is no - or a limited - sense of one another and almost all interaction is 'on-task'. Room for social interaction is limited. Instant messengers, avatars, web-cams, microphones, and software programs for synchronous meetings all try to increase social presence.

The technological context also influence behavior. Gaver (1996) eloquently argues that 'new technologies seldom simply support old working practices with additional efficiency or flexibility. Instead they tend to undermine existing practices and to demand new ones[17]. In this disruption, subtleties of existing social behaviors and the affordances upon which they rely become apparent, as do the new affordances for social behavior offered by technology' (p 112). This suggests that the process of technology design and implementation requires careful attention to established practices within the target community.

Premise 3: The context of CSCL is a unique combination of the technological, the social, and the educational context.

If we look at this statement carefully, we see that it is true of all learning. Learning is - by definition - contextual. Not since the demise of behaviorist learning theories have we thought that we can learn isolated facts and theories which are, in some abstract way, divorced from the rest of our lives. And with the rise of constructivist thought about learning it is accepted that we learn in relation to how we encounter something, where we encounter it, with whom we encounter it, in relation to what else we know and what we believe (Kirschner, 2000; Kirschner, van Merriënboer, Carr, & Sloep, 2002).

Take, for example, the two preceding figures. 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).
CSCL in its usual form represents yet another learning situation. The educational context is one of collaborative learning, the social context is the group, and the technological context is computer mediated[18]. At the OUNL 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 (email, discussion lists, and electronic learning environments) between students.

Premise 4: When technology mediates the social and educational contexts we speak of 'technology affording learning and education'.

This means that the present conceptual framework of technological and social affordances needs to be enriched with the concept educational affordances[19].
Bradner, Kellogg, and Erickson (1999) 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[20] of and contact between employees. A step further is the coffee lounge or water cooler. They allow inhabitants to meet, become aware of each other and casually converse. Dieberger (2000) considers awareness of other people's activities to be an essential ingredient for collaborative work. An overheard conversation and the awareness of what other people are working on can trigger chance conversations in hallways or informal talk that often prove more important for a project then the meeting itself. Mulder, Swaak, and Kessels (2002) confirm the value of such social, non task-related activity noting a marked increase in task/domain related work following sessions in which there was a high degree of social activity between group members.
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 fulfill 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.

Educational affordances are those characteristics of an artifact (e.g., how a chosen educational paradigm is implemented) that determine if and how a particular learning behavior could possibly be enacted within a given context (e.g., project team, distributed learning community). Educational affordances can be defined - analogous to social affordances - as 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 as social affordances. The CSCL environment must fulfill the learning intentions of the member as soon as these intentions crop up while the affordances must be meaningful and must support or anticipate the learning intentions of the group-member. Further, 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.
And what if these affordances are not properly exploited? Take the case of many doors which, for some reason, have pull handles on both sides, but can only be pulled in one direction. An unsuspecting person, is likely to waste half a second or more, over and over again, pushing doors that should be pulled, and pulling doors that should be pushed. We've all done it, and we've all been frustrated by that simple, glaring oversight. And if you think that such an incident will only happen once, think again: We push and pull doors all day, and pay less attention to our surroundings when doing so. In other words, we forget which doors should be pushed and pulled, and act based on the indications we're given, even if they are misleading. And when we do it wrong, we get slightly annoyed but go upon our way. Now consider how CSCL group members feel after they've worked long and hard on an educational problem, only to see after posting their work that someone else has also posted something either duplicating their work or going in a completely different direction. We are not talking about wasting of split seconds nor continuous, small inconvenience in a situation that we cannot avoid (no one will chose not to enter a building because of poorly afforded doors), but rather of wasting large amounts of precious study time and large inconveniences in a situation that the learner CAN (and often does) quit.

(Non)affordances in CSCL environments

The Babble environment (Bradner, Kellogg, and Erickson, 1999) allows users to watch for whether other persons are active and allows the opening of a communication channel with them. This is known as *waylay*. Here, a participant in a group is alerted that another group member has logged on and is active. Knowing this, synchronous communication can be initiated. ICQ® and MSM Messenger® are examples of functionalities or widgets[21] that also make this possible[22].

Since the possibility to communicate in Babble exists, we might also conclude it would be used. Unfortunately, this was not always the case. That waylay was possible did not mean that it was welcomed, that it resulted in helpful interactions, nor that it was viable over the long term. Some remote users feared that others could and would use the affordance to delegate work to them and avoided using the environment[23]. Although Babble supported waylay, it was not socially afforded - here because of the social characteristics of the group. What was missing were group characteristics such as strong social ties, generalized reciprocity, and shared understanding of the limits of what may be asked in a waylay. The social affordances needed in such a situation are:

- *Shared understanding*: the state where two or more people have equivalent expectations about a situation, i.e., their explanations of the situation and their predictions for how it might develop are the same. A lack of shared understanding often leads to *coordination breakdowns* (mismatch between expectations of one participant and actions of another) or *conflict* (the perception of opposing goals, aims, and values).
- *Accountability*: the social mechanism underlying responsible behavior; e.g., not plagiarizing a fellow team member, not working for the disadvantage of a fellow team member.
- *Trust*: the deciding factor in a social process that results in a decision by an individual to accept or reject a risk based on the expectation that another party will meet the performance requirements (Zolin, Fruchter, & Levitt, 2000).
- *Social cohesion*: the tendency of group members to stick together (Sproull & Kiesler, 1991) and the sum of all forces which act on individuals to stay in a group (Festinger, 1968). Simply stated: the tendency of group members to like and trust one another.
- *Predictability*: the quality of a situation that allows those in that situation to foretell that - on the basis of observation, experience, or scientific reason - an expected outcome will turn out to be the actual outcome.

Noteworthy in this respect is the 'awareness paradox' documented by Reffell and Eklund (2002), namely the finding that students appreciate being invisible while online so that others cannot contact them while at the same time wanting extra awareness features to let peers know exactly what they are doing.

Else Veldhuis-Diermanse (2002) concluded in her recent dissertation that although ICT-literate university students were given the opportunity to construct knowledge in a CSCL environment[24] they did not make optimal use of this possibility. Although knowledge construction was relevant for the successful completion of the course, the system did not stimulate the students to construct knowledge – the primary goal. What she found was that the students used the system primarily to exchange information[25]. At the end of her dissertation she presents 29 interventions or "conditions suggested to increase the use of CSCL in university courses". Some are typical educational techniques that should always be part of good education such as: formulate unambiguous learning goals, take care that the students need to follow the course, or organize the course well. Other conditions are specific for CSCL such as: organize regular face-to-face sessions[26], use a transparent and user-friendly CSCL-system, consider moderating discussions, and give students the time to learn to use the system and understand the task. What she actually is saying – in my opinion - is that the tool didn't work and that it needs a lot of 'enhancements' to allow it to work.
The question is: Why do users of CSCL environments tend to accept such imperfections from those environments when they would not accept them from other tools that they use? A different way of saying this is: Did the situation – the combination of the educational, social and technological contexts afford the desired learning?

The key is interaction

We need to dissect the concept 'computer-supported collaborative learning' to determine what a CSCL-environment should entail. First of all we are talking about *learning*, and in the twenty-first century we are usually talking about constructivist learning (Kirschner, 2000). The proximate modifier (adverb) is the word *collaborative*. To collaborate is to work jointly with others especially in an intellectual endeavor. Thus, the work that is to be carried out is learning, and the way that it is done is together with others. Finally, the ultimate modifier is *computer-supported* (a compound adverb). That the computer supports something means that the computer (and some network) enables something to occur and/or that the computer keeps something going. The 'thing' that the computer supports is collaborative learning. This collaboration requires different modes, types, and degrees of interaction. The potential for interaction in a learning group/community arises, as we have seen, from the properties of the:

1 technology (or medium) being used to mediate the interaction,
2 group(s) engaging in the interaction, and
3 learning situation[27].

This leads then to the primary research question for CSCL at the Open University of the Netherlands, namely:

How can CSCL (at the OUNL) be optimized by proper usage of technological, educational and social affordances?

This leads - analogous to the three original research questions posed by Jeroen van Merriënboer in his inaugural address - to the following two research thrusts:

Analyze the combination of educational, social, and technological affordances for collaborative learning.

Design CSCL (environments) and tools for optimizing (the perception of) affordances for learning.

Before going into greater detail about the different aspects of educational affordances in the next section, I would like to quickly discuss those OTEC research projects (in collaboration with the rest of the OUNL) that deal with technological and social affordances[28] needed for effective, efficient and enjoyable CSCL. In other words, those projects which are studying the effects of and designing 'tolls' for CSCL, independent of the educational paradigm used.

Karel Kreijns is currently carrying out a research project on *the sociability of computer-mediated communication, coordination, and collaboration (CM3C) systems*. In his research he has distilled two pitfalls that researchers, designers and users of CSCL often fall into[29]. Although CSCL environments allow (a certain degree) of social interaction to take place, it is no more a matter of course in CSCL environments than in face-to-face settings, and perhaps even less because opportunities for (non-verbal) communication are very limited. To this end he is researching the factors influencing social presence and sociability in asynchronous distributed learning groups and designing and researching the use of a widget for influencing this.

Jan van Bruggen is currently carrying out research on the *use of representational tools in asynchronous collaborative solving of ill-structured problems*, a project which studies the affordances of external representations. He has validated a representational notation to support students in collaboratively solving wicked problems or analyzing proposed solutions to these problems. The notation has, in a series of empirical studies, proven to be useful for analyzing dialogues of those engaged in collaborative problem solving using a coding scheme based on the notation and as such can possibly function as a basis for designing a representational tool for collaborative problem solving.

PJ Beers and Piet Van den Bossche are currently involved in a NWO/MES subsidized project *on knowledge sharing and decision-making in collaborative multidisciplinary teams with*

(a)synchronous computer-mediated environments. PJ, working at the OUNL, is studying knowledge sharing and knowledge building in expert teams with the aid of ICT. Piet, working at Maastricht University, is studying the psychological and social aspects of the management of multiple representations with multiple agents. At this moment they have just completed their first empirical studies based upon a collaborative reference framework.

Marlies Bitter-Rijpkema is doing research on *knowledge elicitation for performance improvement in multidisciplinary teams*. She has designed, implemented and tested a tool for active knowledge elicitation aimed at increasing the transfer of expertise and experiences of team members into an ongoing problem solving process by enabling them to explicate their own more implicit, non-codified knowledge to others. This is not only intended to increase explication and sharing of knowledge, but also to lead to explicit knowledge-objects in codifiable formats that can be transferred for re-use to an organization's knowledge base.

Karen Könings is beginning on a study on the perceptions of designers and users with respect to powerful learning environments. The project attempts to (1) discern the differences in perceptions between designers and students on what powerful learning environments are, (2) determine if taking this into account will lead to a more appreciation, better learning processes and better learning results, and (3) determine how designers can systematically take student perceptions into account.

Finally, in a research project not at the OUNL, but allied to it is Friso Kluit who is doing research on the *cultural influences with the use of CSCL-environments in project centered learning*. His research which takes place in a European, multinational CSCL project financed by the Socrates program aims to determine how "local culture and practice" affects distributed collaborative project centered learning and how cultural barriers can be overcome.

Three factors influencing educational affordances

Most CSCL research focuses on surface characteristics of the environment, the collaboration or the learning paradigm such as the (a)synchronicity of an environment, optimal group size or whether the task was a problem or a project. This surface level approach disavows fundamental questions about the environments such as: Was ICT necessary? Did learners design or prove something? Was the goal divergent and creative (design) or convergent and specific (diagnose)? Who determined the goal, how to reach it and what is correct? Was the evaluation competitive or collaborative? are swept under the rug. This surface level approach is analogous to comparative media studies in education. In his landmark review, Clark (1983) argues that researchers focus on the media used and the surface characteristics of the education they provide. As a consequence, comparative research tends to be inconclusive and the learning materials developed tend to be unprdictable at best and mathemathantic[30] at worst.

In the following sections, I will provide a framework for optimizing the educational affordances of CSCL-environments and with this set the research agenda on CSCL at OTEC. The framework is composed of three non-surface level factors central to the design of any environment, namely task ownership, task character and task control[31].

Task ownership

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 traditional education the institution is the owner[32]. At the macro level this is often the government that not only legislates what needs to be learnt, but also very often determines how it should be learnt and how it should be tested[33]. At the meso level it is the school that does this. The school chooses learning methods and materials, organizes where and how it will be taught and how it will be tested. Finally, at the micro level it is the teacher who determines everything. This 'didactic' approach which emphasizes individual acquisition of knowledge and skills has worked for years, it has been handed down from generation to generation[34] and is very difficult to change.
This approach is also visible in many CSCL- environments which emphasize 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[35] (Kirschner, 2000).

At the other end of the continuum are competency-based environments where not the individual acquisition and application of knowledge and skills 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), as 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 don't 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. The social loafer differs from the free rider in that the first lacks the motivation to add to the group performance, while the last tries to profit

from others while minimizing essential contributions. 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 further support noncontributing members (they refuse to be 'suckers') and therefore reduce their individual efforts.

Individual accountability not only conceptually helps counteract the inability to control and assess individual learning and contribution, but also allows the institution to operationally counteract it. By allowing for and even stressing individual accountability, what the group does as a whole doesn't become less important, but the individual contribution becomes more important. It is perfectly valid that in a group environment, each group member be 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's 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. Team members are linked to each other in such a way that each team member cannot succeed unless the others succeed; each member's work benefits the others (and vice versa). Essential here is social cohesion and a heightened sense of 'belonging' to a group[36]. Positive interdependence is evident when group members in a project-centered learning environment carry out different tasks within a group project, 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).

In collaborative environments, educators often make use of specific techniques that structure a task specific learning activity. Examples of such techniques are Student Teams-Achievement Divisions (Slavin, 1986), Jigsaw (Aronson, Blaney, Stephan, Silkes, & Snapp, 1978; Slavin, 1990) and Structured Academic Controversy (Johnson & Johnson, 1993)[37].

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[38]; Deci & Ryan, 1985; Ryan & Deci, 2000).

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). 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.

Task character deals with questions as: How can we determine whether a task is relevant for the learner(s)? and Who determines whether the task in a collaborative learning environment is relevant? The character of a task can be depicted along a continuum running from constructed, well-defined, convergent tasks to authentic, ill-defined (wicked), divergent tasks[39].

Traditional school tasks are highly constructed, well-structured, well-defined, short, oriented towards the individual, and designed to best fit the content to be taught instead of reality. Archetypal problems of the type are, for example: "Two trains traveling in opposite directions at a speed of … How long …". Such tasks, though often seen as highly suitable for acquiring individual skills, are neither representative for the type of problems that are perceived of as relevant by the student nor 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. In small group learning, Cohen (1994) found that groups were not productive when tasks were closed with only one fixed answer, but were productive when tasks were open to multiple perspectives and solutions. With respect to individual learning Spiro, Coulson, Feltovich, & Anderson (1988) found that the solutions to typical school problems tend to be too obvious for students, so that many students could not solve 'real life' problems involving sets of more real life, complex factors. They conclude that many learning failures, including the inability to transfer knowledge and apply it to new cases, result from just this cognitive oversimplification. Also, since the way learners interpret and make use of situations is influenced by their prior experiences (Akhras & Self, 1996), such tasks - inextricably linked to prior experiences in constructed, often tedious school situations - have almost no relationship to their own real-world experiences and are thus experienced as non-authentic, boring, and often trivial.

At the other end of the spectrum are '*real life*' (authentic) problems[40] that are almost always ill-structured (Mitroff, Mason, & Bonoma, 1976) and/or wicked (Rittel & Weber, 1984; Conklin & Weil, 1997). They are often so complex and multifaceted that they can only be adequately solved by multidisciplinary groups, where group members assuage cognitive conflict, elaborate on each others' 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 more 'yours, hers or theirs'? And so forth.

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 are, after all, never come in neatly constructed segments of some idealized whole[41]. 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 such 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 (1996) enumerates seven epistemic tasks that can be used in the design of collaborative environments. They indicate the 'discourse-bound' activities that learners will have to fulfill during collaborative learning.

Table 1 Epistemic tasks (Ohlsson, 1996, p. 51)

Task	Meaning
Describe	Fashion a discourse referring to an object or event such that a person in that discourse acquires an accurate conception of that object or event
Explain	Fashion a discourse such that a person in that discourse understands why that event happened
Predict	Fashion a discourse such that a person in that discourse becomes convinced that such and such evnt will happen
Argue	State reasons for (or against) a particular position on some issue thereby increasing (or decreasing) the recipient's confidence that the position is right
Critique (evaluate)	Fashion a discourse such that a person in that discourse becomes aware of the good and the bad points of that product
Explicate	Fashion a discourse such that a person in that discourse acquires a clearer understanding of its meaning
Defining	Define a term is to propose a usage for that term

Epistemic task Meaning Describe Fashion a discourse referring to an object or event such that a person in that discourse acquires an accurate conception of that object or event

Explain Fashion a discourse such that a person in that discourse understands why that event happened Predict Fashion a discourse such that a person in that discourse becomes convinced that such and such an event will happen Argue State reasons for (or against) a particular position on some issue thereby increasing (or decreasing) the recipient's confidence that the position is right. Critique (evaluate) Fashion a discourse such that a person in that discourse becomes aware of the good and bad points of that product Explicate Fashion a discourse such that a person in that discourse acquires a clearer understanding of its meaning Defining Define a term is to propose a usage for that term These types of tasks (task classes) are archetypical for competence based learning for achieving 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.

Task control

Task control relates to the shift of control from educational institution or system (often personified by the teacher) to 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). 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[42]. 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 which 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.

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.

With respect to collaborative learning environments, this relates to questions such as: Who determines who does what within the learning situation? Who determines what the *legitimate* pedagogy, content and contribution is; What actions do students have to perform? Who determines which solution or solution path is most adequate, most applicable or best? Is it the teacher/coach who sets the general outline, conditions and constraints, or is the student or student group fully independent in selecting the relevant activities and learning approach?

Conventional wisdom says that the more the learner controls his/her own instruction, the more rewarding the experience will be. 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 overjustification 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. Overjustification 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 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) which shows that not all learners prefer nor profit from controlling the tasks (Carrier, 1984; Millheim & Martin, 1991), and that forcing such control on them can be mathemathantic (Snow, 1980; Rasmussen and Davidson-Shivers, 1998).

Merrill (1983), for example, concludes that college-level students generally do not make good use of learner control options, a position also taken by Carrier (1984). The reason for this is that learners apparently do not have or do not know how to utilize 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) determined 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.

Research at OTEC on educational affordances

Earlier I discussed the research being carried out on technological and social affordances. At this point, I would like to discuss those current research projects oriented towards educational affordances.

Jan-Willem Strijbos is carrying out a research project on *ICT-tools to support role modeling in collaborative and competence based learning environments*, a project which studies the influence and effects of role modeling and role modeling tools on collaborative learning in asynchronous learning groups. These roles are considered to influence accountability and interdependence. The ultimate goal of this project is to provide educational scientific guidelines for developers of GroupWare based education.

Gerard van den Boom is studying *reflection prompts and feedback as a means to foster the self-regulated learning competence*. This self-regulated learning competence entails the learners' ability to modulate their learning according to changing circumstances and to organize learning according to their own purposes. The ultimate goal is to answer the question of how to design and implement study tasks that foster the acquisition of elf-regulated learning competence.

Rob Martens is taking a novel approach to *student motivation in computer based education*. He is investigating the influence of affordances and motivation in various computer based learning environments from an evolutionary psychological point of view. The thrust is thus not on the increase of motivation, but rather on designing educational affordances that are not demotivating. The basic research question underlying this proposal is: How can (intrinsic) motivation be influenced by manipulating the perceived relatedness, perceived autonomy and perceived competence of specific affordances in competency based education?

There is – at the time of this writing - an opening for a Ph.D. student in research project on the *supportive function of performance-assessment in student learning and their competency development*. This research centers on study tasks in competency-based education. The central purpose of this research is to develop a class of study tasks that is supportive to student learning and their development of competencies. The to-be-developed tasks will be perfor-

mance-based, provide supportive and functional information for future learning and competency development, are not directly course bound, and inform students about the desired end-level of the performance so they can mirror their own strengths and weaknesses to this reference point.

Judith Gulikers who has just begun her Ph.D. research is studying *the perception of authentic assessment and its role in the learning process*. The basis of this research lies in the design of authentic tasks in an educational setting, i.e., assignments that have a real-world application, bear a strong resemblance to task performed in a non-educational setting and require students to apply a broad range of knowledge and skills. Her research focuses on new ways of evaluating student learning (also called authentic assessment methods). The primary question is: What are the underlying ideas of developing authentic assessment and learning tasks and how do learners perceive it?

Silvia Dewiyanti is doing research on *the characteristics of learning tasks and learning support as a motor for the collaboration process*. Specifically she is investigating which task characteristics used in a CSCL environments are the most effective for improving learning processes and learning results, what kinds of support should be used, and what the optimal combination of task and support are.

Finally, Frans Prins, Dominique Sluijsmans, and I are carrying out a project entitled *Electronic peer assessment during learning by design*. This project focuses on the design and use of peer and self assessment tasks as educational techniques for enhancing learning in asynchronous distributed learning groups in electronic learning communities. This project investigates the additional value of assessing, of being assessed, and of assessment support for knowledge acquisition and knowledge construction in these groups - both for the assessor (self-regulation / self-assessment) and the assessed (peer assessment / peer assisted learning)

Where's all of this going?

In 1998 Jeroen van Merriënboer presented the first five-year OTEC research program. The aim of the program was the development of "… a comprehensive theory of instruction and instructional design for competency-based curricula and learning environments in post-secondary higher education. Ultimately, this theory should provide guidelines and tools …" (p. 1). He emphasizes in that document that instructional design is not only a process for systematic development of instruction, but also a field of research aimed at the creation of guidelines for the development, implementation, evaluation, and maintenance of situations that facilitate learning.

The program has three research foci, namely design, delivery, and diagnosis of competency-based learning situations. What I propose here is not something completely new, but rather a refinement and an extension of the original foci. It is a refinement in the sense that it is a research and design stream dealing with a specific type of learning situation, namely one involving distributed learning groups (CSCL-environments). It is an extension in that it

emphasizes and stimulates research not only on the educational and technological aspects of CSCL, but also on the social aspects of learning in such environments and how these aspects interact with the educational and technological aspects. It also defines three specific non-surface level factors central to the design of any environment, namely task ownership, task character and task control which will be central to research on the educational affordances of these environments. In other words, it is design centered research on supporting and stimulating learning in CSCL-environments.

According to Don Norman (1992), the major problem with most new technological devices and programs - and in my opinion also in their use in education - "is that they are badly conceived, developed solely with the goal of using technology. They ignore completely the human side, the needs and the abilities of people who will presumably use the devices" (p. 65). Good use – and that means both usefulness and usability[43] - requires a design process grounded in user-centered instructional design research. I propose here a six-stage procedure for the research of CSCL-environments. These stages are:

1 Determine what learners actually do
   We as educators and instructional designers must abandon our own perspective and study the learner's perspective. We must watch students interact, observe collaborating groups interacting to solve problems, observe users interacting with software, et cetera, and do this *before* we begin to design and develop.
2 Determine what can be done to support those learners
   We must not be seduced from our own knowledge and ideas to determine what is technologically, educationally, or socially possible and then build, implement or stimulate it. Instead we must determine, based on stage 1, what actually needs to be supported / afforded and then proceed.
3 Determine the constraints of the learner, learning situation and learning environment and the conventions that already exist
   What physical, logical and cultural limitations will we encounter when trying to implement the support and what constraints will the learner encounter when trying to use that support? What conventions already exist and are we introducing new ones? Of paramount importance here is that we look further than the technological constraints and conventions and take into account the educational and social constraints and conventions that play a role in CSCL. The OUNL is an institution for higher education whose students are products of between 12 and 16 years of educational experience (indoctrination?), As such they are used to certain types of education and have been socialized to study, learn and act in specific ways. Denying or neglecting this will guarantee failure, both of our work and of their learning.
4 Determine how learners perceive and experience the support that we provide
   There is a world of difference between our (good) intentions and user perceptions thereof. We need to see and carry out research and design as iterative, interacting processes. We must verify our work by making ample use of prototypes, mock-ups and

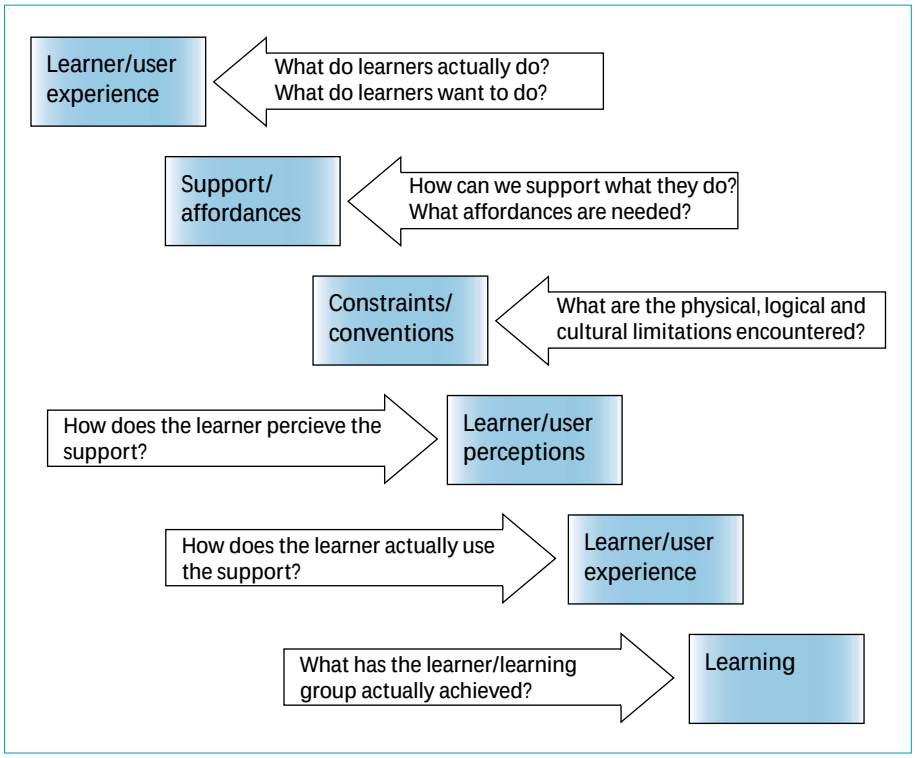
incremental design procedures. We must try these 'products' out with intended users at stages in their development where physical and conceptual changes can still be made. In this way we can assure not only the usefulness of the support (does it achieve what we want it to achieve?), but also the usability of that support (is it clearly defined such that its use is easily and correctly perceived by the learner?).

5 Determine how the learner actually uses the support provided

Analogous to stage 1, and following up the more formative evaluations carried out in stage 4 we need to determine if the learner actually does what we hope / expect that (s)he will do.

6 Determine what has been learnt

The goal of education is learning and there are three standards which can be used 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 these without a concomitant decrease in any of the others means success. This is the proof of the pudding.



Are two heads really better than one?

There's a radio show I often listen to called Car Talk®[44]. Two dropout physics Ph.D.s who – disenchanted with university teaching – started a do-it-yourself garage in Boston and try to answer listener questions about cars (and lots of other things). On one occasion a caller posed a question about electric brakes on a cattle carrier. Unencumbered by the thought process as well as by any knowledge about electric brakes or cattle carriers, they waxed prolifically to give an answer. The next week the following letter arrived, which they read on the air (October 24, 1997):

> *I am writing to offer profound thanks to you for resolving an important philosophical question … Do two people who don't know what they are talking about know more or less than one person who doesn't know what he's talking about?*
> *In your recent conversations regarding electric brakes on a cattle carrier, I believe you definitely answered this query … Amazingly enough, you proved that even in a case where one person might know nothing about a subject, it is possible for two people to know even less!*
> *One person will only go so far out on a limb in his construction of deeply hypothetical structures, and will often end with a shrug or a raising of hands to indicate the dismissability of his particular take on a subject. With two people, the intricacies, the gives and takes, the wherefores and why-nots, can become a veritable pas-de-deux of breathtaking speculation.*
> *I had always suspected this was the case, but no argument I could have built from my years of observation would have so satisfyingly closed the door on the subject as your performance on the cattle carrier call. To begin your comments by saying, "We'll answer your question if you tell us how electric brakes work" and "We've never heard of electric brakes" and then indulge in lengthy theoretical hypostulations on the whys and wherefores of the caller's problem allowed me to observe that you were finally putting this gnarly question to rest.*
> *I am forever indebted to you for the great service you have performed! I'm truly impressed that it took so many years of listening to your show to finally have this matter resolved.*

All joking aside, although it is apparently possible that two people can be dumber than one, we will assume that by working together people will be able to achieve more and different things than if they work alone. In business this means that solutions are more creative and innovative, that products are more effective and efficient and that businesses (both the employees and the company as a whole) get smarter. In education, this means that students learn more and institutions expand their resources to design, develop and deliver better education. For educators, this means that we must afford such learning environments.

Acknowledgements

I've now arrived at the end of my address, where I get to thank people. Although there are many people who need thanking, I'll use this space to single out a few.

First I would like to thank the members of the Board of Governors of the Open Universiteit Nederland for their faith in me, especially the Rector Magnificus Prof. dr. ir. Fred Mulder. Fred: We've come a long way together, but still have a long way to go.

Second, I would like to thank Prof. dr. Wim Jochems, the Director of OTEC. When you first arrived at OTEC I was going through a difficult period. From our first discussion you made it more than clear to me that you valued me as a scientist, as a colleague and as a person. By doing so you made it easy for me make a difficult choice; and when I made that choice you actively supported it. I came back home to OTEC. Then, when an appointment at OTEC became a possibility, you actively supported it and in doing so made a second difficult decision for me, namely returning to the OUNL full time, also easy to make. Thanks Wim.

Then there's Prof. dr. Jeroen van Merriënboer. I as a staff member, and we as a department, couldn't ask for a better head of research than you. You played an important role in my appointment, you are an inspiring person to work with, your are a fabulous model to learn from, and you are a topper in your field. You know how to lead when necessary, delegate when expedient, and how to pave the way for others - a rare talent in these very egotistical times. It's an honor and a privilege to work with you and to learn from you. It's also lots of fun after hours! Thanks Jeroen.

I'd also like to thank all of my colleagues at OTEC, especially those who take care of me. First my Ph.D. candidates - Jan, Rob, Liesbeth, Karel, PJ, Piet, Friso, and Judith - who inspire me, work incredibly hard, and make sure that I don't have any idle time to go down the wrong path. Thanks! Then there's the business office. Thank you Natascha, Ingrid, Sandra and Roos for doing your best to make my complicated life a little simpler. Marion, thanks for organizing this whole circus. Jos, thanks for always managing to find a way to get things accomplished. And Freek, thanks for having that uncanny knack of helping me see that everything is relative.

Dad, thanks for always having this idealistic idea about what I could do, along with a limitless love of and belief in me.

Femke, Jesse, Mara and Aron: If an affordance helps or aids someone to do something, then you truly afford my life. Thanks for accepting the fact that I'm sometimes absent (either in mind, body or both), and for always making it more than apparent what's really important.

And finally Catherine. Even more than the last time, nothing I can say can express my love for and gratitude so I won't even try. You, more than anyone, afford my existence. Thank you for being you.

I have spoken.

Notes

[1] Ashley Montagu, born Israel Ehrenberg in East London in 1905, was a man of learning who made substantive scholarly contributions to academia while maintaining contact with the educated layman. He was a dedicated and articulate social critic, concerned with bringing the findings of the social and biological sciences to bear upon the betterment of humanity, while subjecting some of those very findings to critical social scrutiny. See further: http://www.aect.org/Intranet/Publications/edtech/35/35-05.html

[2] *Cooperative lesson planning*. Presentation given at California State University at Sacramento

[3] Collaborative and cooperative learning are not the same. According to Panitz (1996), while collaboration is a philosophy of interaction and personal lifestyle, cooperation is a structure of interaction designed to facilitate the accomplishment of an end product or goal through people working together in groups. Although different, they share a large number of assumptions and areas of agreement such as:
• learning takes place in an active mode,
• the teacher is more a facilitator than a "sage on the stage",
• teaching/learning are shared experiences between teacher and learner,
• students participate in small-group activities,
• students must take responsibility for at least part of their learning,
• discussing/articulating ideas in a group enhances the ability to reflect on assumptions and thought processes,
• social and team skills can be developed, and
• students profit from belonging to a small and supportive academic community.

[4] Using the term computer-supported is as true and as superfluous as specifying any other educational support. We don't talk of book-supported learning, although the fact that we have text books means that teachers, students, parents, educational testing institutes, and the rest of education can act in a certain way. Teachers don't have to cover all content, but can chose what to cover and more importantly what to elaborate because they know that 'the rest is in the book'. They can assign (home)work, compose tests, et cetera thanks to the book. Parents, in turn, can drill their children for those tests because there are those books. Ad infinitum.
Computer-supported is also a misnomer. A computer doesn't support collaborative learning; the combination of computer, software and connection does. All three support collaborative learning in (a)synchronous distributed learning groups.
A better term might be *web-enabled*, but for the sake of clarity I will continue to use the term computer-supported.

[5] The concept of affordance has been the subject of much debate, mainly with reference to its *ontological* status. The main question that is debated is whether affordances are properties of the environment or of the relation between the observer and the environment and how it relates to the intention of the observer.

[6] Don Norman goes so far as to state: "If a design depends upon labels, it may be faulty … Whenever labels seem necessary, consider another design" *The psychology of everyday things*, p. 78.

[7] This misuse led Norman to publish the paper "Affordances, conventions, and design (1999). In his own words: I was quietly lurking in the background of a CHI-Web discussion, when I lost all reason: I just couldn't take it anymore. "I put an affordance there," a participant would say, "I wonder if the object affords clicking. "Affordances this, affordances that. And no data, just opinion. Yikes! What had I unleashed upon the world? "No!" I screamed, and out came this ….

[8] *Misuse*: People speak of affordances of the graphic user interface on a monitor screen. In the strict sense, a screen has only one physical affordance, namely a VIEW affordance.
Useless: Although all screens that can be reached afford touching, only some can detect the touch and respond to it. Thus, a display that isn't touch-sensitive affords touching, but touching it has no effect on the computer system.
Accommodation: A computer system comes with built-in physical affordances. The computer, with keyboard, display screen, pointing device and selection buttons (e.g., mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the screen. This combination has led to the broadening of the concept of physical affordance to include the technology affordance of the screen and input devices working in concert to afford different types of input.

[9] According to Gibson, the perceiving organism and the environment are intimately related. The environment does not provide 'objective' information equal for everyone, but rather different opportunities depending upon the actors and their needs. Affordances are - in Gibson's view - resources which are revealed to those who seek them. A tree in the middle of a field on a summer's day is only an affordance to those who seek its cool shade. An affordance, thus, is the *link* between *perception* and *action* in which the performance of an action is based on the "fit" between the physical capabilities of the actor and the constraints imposed by the environment.

[10] Note the use of the word 'experienced'. This is an example of how the simple, thoughtless 'see-do' coupling is mitigated by learning.

[11] This doesn't mean to preclude the fact that certain innate, possibly biological or evolutionary factors may also play a role (at first). Before a convention exists or in situations where we may not be able to speak of cultural conventions (lower primates for example) factors such as perceptual uniqueness, curiosity or novelty may play a role. Computer-game manufacturers make use of this, and in doing so create new conventions.

[12] Arbitrary does not mean that the choice is random (Norman, 1999). It means that there is "nothing inherent in the devices or design that requires the system to work" in a certain way. The choice made is usually "an intelligent fit to human cognition", but there could be alternative methods that would work equally well.

[13] *Power distance* is the extent to which unequal distribution of power is accepted in a society.
Uncertainty avoidance is the degree to which a society can deal with ambiguity and to tolerance for deviation from the norm; the need of structure, social conformity and absolute truths.
Individualism vs. collectivism refers to the degree to which one attaches values to his/her own self rather than to collectivist values.
Masculinity/femininity refers to the social gender roles in a society. In a masculine society men are supposed to be assertive, tough and focused on material success whereas women are expected to be more modest, tender and concerned with the quality of life. In a feminine society social gender roles overlap - both men and women are supposed to be modest, tender and concerned with the quality of life

[14] Granger didn't speak of distributed learning, but rather of distance education. I have chosen to no longer use the term distance, since it has - in my opinion - lost all meaning. Learners in the same school are becoming just as likely to work in groups distributed in time and place as are learners spread across a country or even around the world. I have chosen to consistently speak of study or learning - as opposed to education - since I try to always take the view of the one who learns (and thus must perceive the affordances and use them) instead the institution that educates and 'provides' the affordances.

[15] And what about this table?

[16] A CMC system is a software system running on a networked computer that allows a user to communicate (socially interact) with other users running the same or a compatible communication system on their computers. A CMC system usually consists out of single communication channel but may encompass multiple communication channels. To fulfill the needs of asynchronous distributed group learning, the CMC system has to be augmented with subsystems that allow for group coordination and group collaboration. The augmented CMC system becomes a computer-mediated communication, coordination and collaboration (CM3C) system. This means, that in addition to the 'normal' communication-enabling functionality, a CM3C system also has a coordination-supporting functionality, and and collaborative functions allowing the shared usage of material, programs, and information sources.

[17] An interesting example is the introduction of the escalator. Originally meant to speed up the movement of people on a staircase (you can move twice as many people in the same time because their stair climbing speed is enhanced by the speed of the escalator) it has slowed the pace down and has led to congestion at the top and bottom of escalators since people have chosen to stand still and 'ride' the escalator.

[18] CSCL must not be seen as a single learning situation. The educational context can vary from carrying out convergent, highly structured artificial tasks to solving divergent, ill-structured or wicked real life problems. The social context can vary from intense dyadic interaction to 'working alone' in a large group or discussion group. And the technological context can be one of bare bones, text based CMC or richly mediated CM3C.

[19] I chose the word educational here although I actually mean learning. Although this sounds strange, the reason is simple. The goal of education is (hopefully) learning. Learning is something that the individual does. (S)he does this from the moment (s)he was born and will do this until the moment (s)he dies. In this case, learning is almost synonymous with experiencing; both intentional and non-intentional. When learning happens in an institutional setting, we call this education. Since we at institutions of higher education have the responsibility for creating effective, efficient and satisfying social, technological, and learning contexts I use the word educational.

[20] This awareness brings social rules into play which govern actions. When someone is busy, it is considered rude to interrupt her/him. Erickson 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.

[21] A widget is an element of a graphical user interface that displays information or provides a specific way for a user to interact with the operating system and application. Widgets include icons, pull-down menus, buttons, progress indicators, and many other devices for displaying information and for inviting, accepting, and responding to user actions.

[22] ICQ® (pronounced "I-Seek-You") and MSN Messenger® are online instant messaging programs; conferencing tools used by individuals on the Net to chat, e-mail, perform file transfers, play computer games, and more. Once downloaded and installed on a PC, lists of friends, family, business associates who also have the program on their PC's can be created. ICQ® and Messenger® use this list to find friends and notify the user once they have signed onto the Net. The user can then send messages, chat in real time, play games, etc.

[23] This is not very strange if we consider the original (actual) meaning of the word *waylay* in the real world namely to lie in wait for or attack from ambush! (Merriam Webster's Collegiate Dictionary)

[24] Dr. Diermanse-Veldhuis used Web Knowledge Forum (WebKF, 2000), an asynchronous CMC system developed by the Ontario Institute for Studies in Education (http://www.learn.motion.com/lim/kf/KF0.html)

[25] Although information exchange is a key goal of communication, by focusing (our theories) exclusively on information we overlook the social processes that scaffold information exchange
Nardi, B. A. and Whittaker, S. (2001). The place of face-to-face communication in distributed work. In P. Hinds & S. Kiesler (Eds.), *Distributed Work*. Cambridge: MIT Press.

[26] This presents an interesting paradox, namely the suggestion that regular face-to-face meetings be organized to optimize distributed learning!

[27] These three properties concur with Kuutti and Bannon's (1993) three perspectives on human computer interaction: the *technological* level, the *work* process level, and the *conceptual* level.

[28] At this point I discuss those projects which do not specifically deal with educational affordances. The achievements of these projects can be applied to all types of CM3C systems. Later in this address I will discuss those project which directly relate to educational affordances.

[29] The first pitfall is taking for granted that social interaction will just 'happen' in distributed learning groups since the CSCL environment makes it technologically possible The second is restricting social interaction solely to cognitive learning processes and ignoring the importance of the social(-psychological) dimension of interaction for group forming and group dynamics in developing learning communities. This is traditionally called off-task interaction.

[30] From the Greek: *mathema*=learning + *thanatos*=death
Ernst Rothkopf originally coined the term mathemagenic in referring to activities that give rise to learning (mathema=learning + genes=born. Rothkopf, E. Z. (1970). The concept of mathemagenic activities. *Review of Educational Research, 40*, 325-36.
Dick Clark coined the term mathemathantic specifically in relation to how, in attempting to make use of aptitude treatment interactions, teachers and instructional designers can kill learning.
Clark, R. E. (1989), When Teaching Kills Learning: Research on Mathemathantics. In H.N. Mandl, N. Bennett, E. de Corte and H.F. Freidrich, *Learning and Instruction. European Research in an International Context*. Volume II. London: Pergamon Press Ltd.

[31] A word of thanks is in order here. It all began one evening in Maastricht at Murphy's Irish Bar where a session was organized to discuss the differences between problem-based and project-centered learning. A group of us came to the conclusion that the difference lay deeper than the simple surface level descriptions of problems or projects. A second session followed at the home of one of the barflies where an unpublished paper by Tim Koschman served as starting point to discuss the deeper levels. Two of us, Wim Gijselaers and myself, continued this quest with different people along the way such as Jan-Willem Strijbos and Rob Martens, trying to get our ideas into a publishable form. The paper, though broadly circulated and broadly applauded, also hasn't been published. Some of the ideas are finally seeing the light of day here.

[32] This is a reflection of the fact that we often, unconsciously, speak of teaching and not learning, educational goals and not learning goals, pedagogy and didactics instead of learning sciences, and so further.

[33] This is the major complaint in the Netherlands with respect to the 'second phase' of secondary education. After determining the end terms, the government then legislated both the content in detail and the pedagogy for achieving it. Finally they worked out an elaborate testing scheme.

[34] Teaching is one of the few professions that uses an apprenticeship system. Pupils/students are actually apprentices. They spend 12-16 years apprenticing the teaching profession; seeing and experiencing it from all angles. Then comes teacher college and the experience as journeymen (excuses for the sexist language; journeypeople is a step too far for me). In many systems this continues for the first years after graduation. Finally, they become masters in the trade. In other words, by the time someone is considered a 'teacher' (s)he has experienced/been indoctrinated in the system for nearly 20 years.

[35] Assessment must reinforce rather than contradict the educational approach adopted due to the strong interactive/reciprocal relationship between (the perception of) assessment and the way the perceiver learns. If the learner knows or expects that (s)he will be tested in a certain way, (s)he will adapt the learning to satisfy that expectation, regardless of the way the instruction is designed and presented.

[36] 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. … Promotive interaction is characterized by individuals providing each other with efficient and effective help and assistance, exchanging needed resources … acting in trusting and trustworthy ways, being motivated to strive for mutual benefit …. Promoting each other's success results in group members' getting to know each other on a personal as well as a professional level" (p. 1028-1029).

[37] *Student Teams-Achievement Divisions* distinguishes three stages: teaching, teamwork, and individual assessment. In the teaching stage the teacher presents the learning material. In the teamwork stage, students in heterogeneous teams help each other build a shared understanding. In the individual assessment stage team members show their individual knowledge on a quiz (or equivalent procedure) without any help. The team is rewarded based on the degree to which team members have improved over their own past records.
Jigsaw segments the content into as many sections as there are team members in heterogeneous groups. Members have to study their section of the content with members of the other teams who have been assigned to the same section; together they form an 'expert group'. After they have become 'experts', they return to their teams to share what they have learned. Team members are assessed on their individual knowledge of the whole content. Because there is no team reward, this technique is high in task interdependence and low in reward interdependence
Structured Academic Controversy is based upon the premise that conflicts arising from controversies, will drive/motivate students to be intellectually engaged with the learning material and, as such, fits situations in which controversial subjects are discussed. A group is split into two pairs and is assigned opposing positions. The pairs develop their position, and have to advocate their perspective to the other pair. The aim is that the two pairs seek a synthesis that takes both perspectives and positions into account, representing the collaborative learning part of the technique.

[38] Self-determination 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.

[39] Van Merriënboer uses a related term, task classes - an abstract, general description of a broad category of learning tasks.

[40] This is a paradoxical, possibly even a philosophical situation which is hard to address. What is authentic, what is real, and even what is a problem is very personal. As such it is a very 'constructivist' concept. What may be real, authentic or a problem to one person is artificial, constructed, and non-problematic to another. What a teacher or instructional designer thinks is a motivating, relevant task is not necessarily relevant or motivating to the student, or at least perceived as such.

[41] Jeroen van Merriënboer in his *Four Component Instructional Design Model* holds that environments for complex learning can always be described in terms of four interrelated components that are based on the four categories of learning processes that are central to complex learning (learning tasks, supportive information, just-in-time information, part-task practice). The first component, learning tasks, deal with concrete, authentic "whole-task experiences" that are provided to learners in order to promote schema construction for non-recurrent aspects of a skill and, to a certain degree, to promote rule automation by compilation for recurrent aspects.

[42] Ross and Morrison (1989) noted that the idea that learners can be given control of their own learning is rooted in two assumptions [PK: which are hotly debated] namely: learners know what is best for them and learners are capable of acting appropriately on that knowledge. The debate is epitomized 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.

[43] Usefulness is related to whether the right functions (affordances) are designed and developed to do what has to be done; usability is related to whether the functions (affordances) are clearly defined such that the information specifying them is easily and correctly perceived.

[44] Car Talk® is a program produced by WBUR in Boston, Massachusetts for National Public Radio.

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