Questioning Gender in E-learning and its Relation to Computer Science; Spaces for Design, Working and Learning

Cecile Crutzen
School of Informatics
Open University of the Netherlands

Introduction

The domain of Informatics is a world of actors in which ICT-representations are designed and used, presented and interpreted. ICT-(re)presentations are present in this world not only in the form of hardware or software but also as methods and theories used for designing and making ICT-products, are representations within this world, too. The Informatics discipline (Computer Sciences) is a part of, and an actor in a world of interaction in which ICT-presentations are present and used in the interaction itself: between people, between machines and between people and machine. E-learning created an interaction world in which ICT-representations are designed and used.
In the discipline Informatics only little attention is given to gender aspects. The dominant attitude is that its products and its acting are, or should be, gender-neutral. Gender is seen as "outside" the discipline. Gender itself is recognised just as sets of fixed characteristics belonging to two generalised types of human being. "Female" qualities are seen as only useful in the interaction between professionals and users. Questioning gender in Computer Science in the past was mostly reduced to asking what the position of women in Computer Science was, or to searching for the causes why relatively few women are professional ICT-designers.

The “programmers” Akke Visser en Lily de Ronde with the digital computer system Miracle. (Photo Shell)

Control of a print in Taiwan, (Photo Vincent Menzel)

Women and Informatics

So questioning gender in the domain Informatics often meant looking at the "interaction" position of women; to what extent were women involved in controlling ICT developments?.[1]
In the nineteen fifties and sixties women in the western world’s computing were the

[1] See for an overview of participation of Women in ICT-professions and measures to address gender inequality in ICT related occupations and to adress teaching ICT skills and knowledge:
(Millar, 2001), (Kirkup, 2002) (Clayton, 2003) (Brekel, 1999)

"programmers": But programming in those days was undervalued work in comparison with the mathematicians, which did the more intellectual part of the job – as they thought. When programming became a high qualification job, women disappeared from the it (Oost, 1991). In E-learning the same, from the dominance of technology resulting trend can be seen now in the area of Instructional Design.

.

Japanese women in assembly work
(Photo ILO)

In the nineteen seventies and eighties women in the Third World became as Donna Haraway noted: "*... the preferred labor force for the science based multinationals*", the chip industry and the data entry industry. (Haraway, 1991, p.166)

In the eighties many women turned away from the machine, interpreting the machine as dominant. Women rediscovered computers in the nineties, now as a tool for textual interaction and for human communication. Women took electronic supported interaction positions of pleasure and usefulness. Through the demand of easiness women became the ultimate users. The focus of the gender oriented designers, "women friendliness", was equal to "non-problematic simple interfaces".[2] According to Elizabeth Lane Lawley the writings on gender and computers was pervaded with the concept of coherent and stable gender. Even feminist writers described women as the users and necessarily only the objects of information technologies. These descriptions are often loaded with essentialist characterisations of women in general and based on technological determinism: *"...authors who intend to expose and thereby end the marginalization of women in technology, may well be reifying the very gender relations they criticize".* (Lawley, 1993)

[2] "*Unfortunately, the concept of coherent and stable gender roles pervades much of the computing culture, and is often the focus of writings on gender and computers. Even feminist writers critiquing the interaction between women and technology often fall into a pattern of describing women as the users and necessarily only the objects of information technologies"* (Lawley, 1993)

For Susanne Bodker and Joan Greenbaum, reducing the gender perspective to the positions of women and man is not constructive: "*Our use of a gender perspective to the study of computer applications is not to bemoan the differences between men and woman, for we feel that this unfortunately leads us back up the path where we find ourselves, once again, looking at 'women on a pedestal' or 'women as victims'.*"
For them a gender perspective could (...) "*reframe the way we go about looking at offices in order to begin mending the head and heart and going about the process of designing systems that better suit the people who use them*." (Bødker, 1993, p.57)
Although focussing on "the office" or other domains where the position of women where mostly only articulated as the users of ICT products, their research opened up in Informatics the participation differentiation in the design-process of ICT-systems and its gender aspects. (Clement, 1993)
Questioning E-learning from a gender perspective means in my opinion, not forgetting the position of female designers, teachers and learners but above all thinking of how to create active and autonomous positions of learning in the domain of E-learning.

Questioning Gender in E-learning
Reducing the gender question to the position of the female learner means mostly only asking the traditional questions about women as users of E-learning environments such as "equal access". Of course, it is important

- to implement strategies to ensure equal access for men and women, and to provide additional support to make sure that women are not at a disadvantage.
- in some situations to give attention to the differences in communication styles and the different ways of "knowing" and learning and the different way, women manage their online identity.
- having insights into the motives of women to learn online and the characteristics of women who are successful as online learners[3].
- Of course it could be important to know if women write more or less, shorter or longer messages compared with men, but we have to realise that promoters of E-learning technology often see only its positive aspects. Their standpoint is that E-learning has many advantages for teachers and learners; the Internet is easily accessible globally. E-learning offers integrated presentation and communication facilities. Electronic course material provides better opportunities for updating and re-use.[4] The promoters do not ask the gender question and they seldom analyse and criticise the given positions of participation and involvement of the female learners in design activities in behalf of the learning material or in the learning activities themselves. In publications on the participation of women, the actual trend is that women are doing well in E-learning environments in comparison with men: *"... women were taking control of the sessions; not „sitting on the sidelines"" ... They were participating equally, and at large, were dominating the discussions, while retaining a collaborative environment. Thus, in contrast, to previous research, the CMC contexts of this research project were dominated by a feminine presence. ...the virtual realm is a female domain and rejects the theoretical argument that the Internet is a „men's club". ...The findings from the content analysis of the online discussion sessions are representative of the*

[3] See f.i. video presentation of the Gender and the Digital Divice Seminar Series in collaboration with the ISN Quickstart Program: Gender and Global E-learning (September 12, 2002),"www.worldbank.org/wbi/B-SPAN/sub_digital_divide.htm", "www.knowledgefordevelopment.com/Teaching/gender.htm",
[4] See for an overview (Virkus, 2000) (Meyers, 2003)

notion of the cyber world as a feminine arena." (Monteith, 2002)

However, this "E-technology push" in learning does not always improve the quality of education. Web technology mostly yields a backward-push rather than a forward-push. E-Learner activities mainly consist of reading from the screen and filling in boxes. They are offered to the learner as passive or closed procedures. (Merriënboer, 1999) It is more likely to assume that the outcome of some research, that "Women are successful in online learning", is not owed to the offered quality of online education. Women are successful because they are talented jugglers, efficient time managers and better self-regulators. Women are able to multi-task, to deal with interruptions, and to reschedule. E-learning offers the possibility to fit learning activities into your own agenda: „*The flexibility, the ability to control their time and coordinate work, school, and home responsibilities is a watchword for women who prefer online education and is a particularly strong selling point for adult women students who typically bear the brunt of family and work responsibilities. When it comes to education, time may be a more precious commodity than money for some of these women*." (Kramarae, 2001, p.11)
The trend that women are presently doing well in E-learning environments should not make us forget the warnings from earlier research findings. As Kirkup has mentioned digital media can produce a lot of inflexibility for women engaged in learning. Research on the participation has showed that girls and women are less enthusiastic about using ICT that men and boys. „*There is a danger that if ICTs are used to replace traditional media -simply because of an enthusiasm for them, or because the economic strategies of governments puts pressure on educators for their use, - rather than their use growing out of their proven value as educational tools, women in particular will be disadvantaged. Women's participation in traditional open and distance learning has sometimes been despite the barriers that technology has put in their way"* (Kirkup 2002, p.12)

The results of research on the participation of women in E-learning as learners are not conclusive. What are the gender aspects of E-learning? Should we ask the same gender questions of E-learning as of "regular" learning environments? (Meyers, 2003) If not what are the new questions? It is impossible to give a complete answer but an exploration is useful. We should look in more detail at the interdependencies of Computer Science and Instructional Design, because reducing the gender question in E-learning to the position of women only, we have lost a critical constructive gender position. This analysis is necessary to fulfil Kirkup's recommendation to „*distinguish between the use of ICTs as general tools in education and specialist education in computer science and informatics*" (Kirkup, 2002, p. 13)
The gender view of E-learning might focus on the woman's view: on topics like the "access problem" or on claims for enabling modification of learning systems with the tuning of "computer literacy" levels. But this often results in grounding the learner's participation and the teamwork options on presumed attributes and demands of women. It is certainly useful to analyse, why and how women experience learning environments as advantageous or not. But E-learning should not be a domain where proper learning environments for humans are justified by a matrix of male-female attribute's oppositions (Meßmer, 2004).

"Questioning gender" is a strategy to disrupt closed learning environments in which the learning process is reduced to a procedure of formal and planned acting of learners and where learners are seen as objects with predictable behaviour and modelled with static learner profiles.

Instructional Design and Computer Science

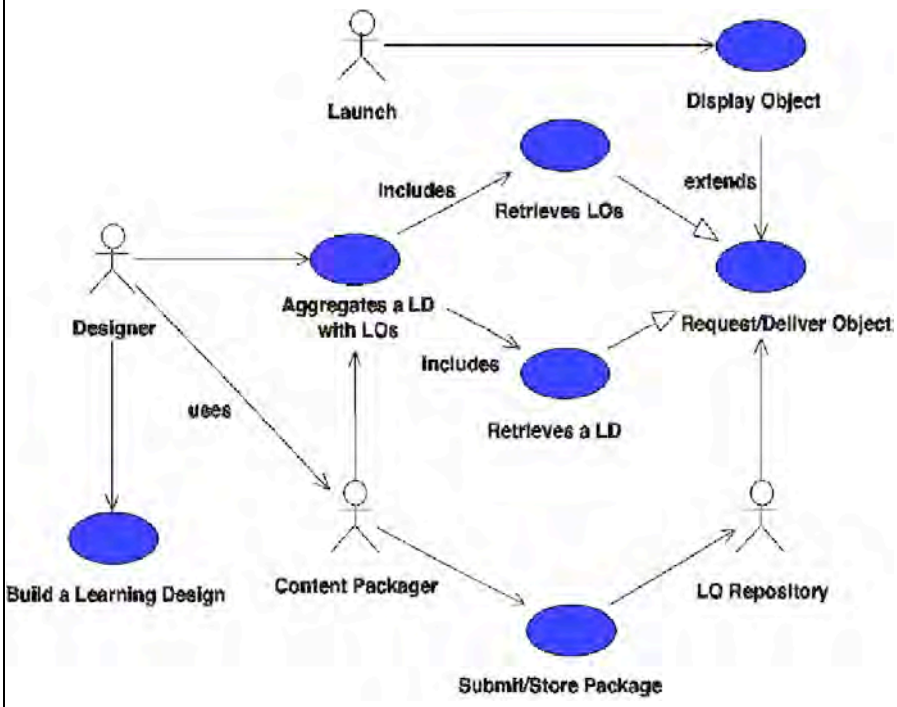
E–learning design is often seen as a part of Instructional Design, the discipline that supports or facilitates planned and intentional learning. Its goal is making ready planned learning activities for humans: students and teachers: "*Instructional Technology is the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning*." (Seels, 1994)

In the production of E-learning material specialised instructional designers (learning technologists), are involved. Computer scientist and instructional designers work together harmoniously for the production of E-learning material, because both disciplines are involved in making planned action and interaction. However in this cooperation they often forgot that the two disciplines have different target groups. In Computer Science the goal is making ready-made planned action for machines. Using ICT-representations for ”learning” is using the epistemological and ontological assumptions inscribed in the models of analysis, design, implementation and realisations of ICT-systems.

Paquette proposed a new approach and definition of Instructional Design, founded on cognitive science, and labelled as Instructional Engineering: „*... a method that supports the analysis, the design and the delivery planning of a learning system, integrating the concepts, the processes and the principles of instructional design, software engineering and cognitive engineering".* (Paquette, 2004)

The representations of Computer Science: hardware, software, methods and theories are taken for designing and making E-learning products, as ready-made scripts for learning activities. John A. Finnis is not so optimistic about the electrification of learning material but he also highlights the planning of education: „*Delivering content electronically does not automatically transform it into an effective aid to learning. In fact what might have been a very good aid to learning in its original form may lose its merits through inappropriate “electronification”. The most effective use of learning technology requires considerable planning and effort on the part of the educator to best exploit the strengths of the target media*“. (Finnis 2004)

In my opinion making planned action in E-learning could turn students into learning machines. Teachers are reduced to the role of implemented programmed artificial intelligent software agents. The focus of instructional designers is to create models of how designers can assemble learning material, it is not focussed on the design activities of the learners as showed in an example of Paquette: In his UML use case diagram (comment: unified modelling language use case, a modelling method developed for specifying the functionality of information systems, in which interaction can only modelled as impulse-response pattern) he shows the designer as the main actor involved in building a learning design. (Paquette, 2004



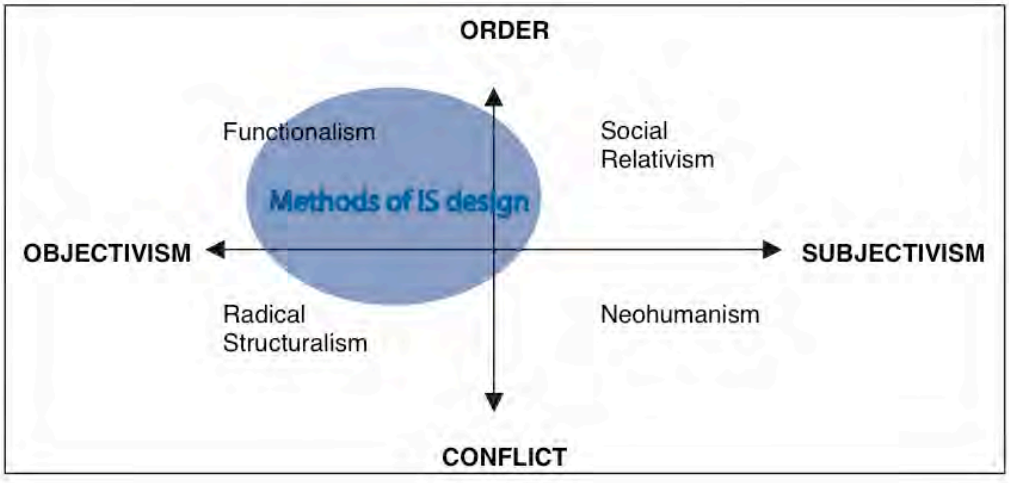
The UML use case diagram (comment: unified modelling language use case, a modelling method developed for specifying the functionality of information systems, in which interaction can only modelled as impulse-response pattern*) shows the Designer, as the main actor involved in building a learning design. Basically, he/she aggregates a LD* (comment: learning design*) structure with content learning objects, for example, associating one or more resource or object with the learning activities where they are used or produced. The designer has to retrieve a LD and a number of content LOs* (comment: learning object*) from learning objects repositories, by making a request/deliver (search) operation. This operation will be extended by a display-object operation*."
Example from (Paquette, 2004)

The interconnection of E-learning and Computer Science becomes apparent in the attempt to mechanize the learning processes by shaping and modelling them into "Taylorized" learning-programs. These are focussed on transparent controllability. Commercial factors are the main motive for institutes and course developers to evolve patterns of ready-made E-learning. Through speeding the transfer of knowledge, increasing participant's motivation, extending the standardization potential, simplifying quality control and narrowing the specification of learning processes, they expect a higher learning efficiency and cost benefits. (Severing, 2003) E-learning then becomes used to drill self-contained chunks of knowledge, prefabricated as hierarchical hypertexts, into the students' heads. This forces the students to work through it in a uniform way. In addition to this pre-planned and mandatory interaction, scripts are offered. The interaction between a student and an E-learning unit is modelled and implemented as a controllable number of impulses. To reach the predefined "success" criteria, students have to match exactly the required responses. Subject matter, teacher behaviour and student behaviour become digitised and ready-made as reusable learning objects.
It is an often-used strategy in E-learning to introduce learning management systems, where the learning processes are implemented as linearised hierarchical procedures, firmly linked by conditional branches. These branches are offered, or refused, automatically on basis of

specified assessment scores. The learners hardly can evade this forced control. This learning design assumes learning to be a mechanical push-process, and not an exploring and constrictive design-process (Li, 2000). This explains common complaints that rigid teaching manners in E-learning are widespread: "*In the scope of E-learning a didacticism is reanimated which in classical education has been overcome*" (Severing 2003). Learning situatedness and its problem orientation is being lost completely.

The methods and models of Computer Science in Instructional Design

Expecting the renewal of education from a very conservative discipline such as Computer Science, still committed to the paradigms of its original disciplinary sources, such as mathematics and electrical engineering is contradictory. Although the statement that Computer Science is a conservative discipline sounds surprising, because a lot of innovative electronic communication and interaction products are connected to that discipline. Hirschheim, Klein, and Lytinnen analysed information system design methods. They used a framework adapted from Burell and Morgan (Burell, 1979) to classify the assumptions within these design methods along two dimensions: a subjectivist-objectivist dimension (epistemological dimension) and an order-conflict dimension (views on the social, physical and technical world, the ontological assumptions). With these two pairs of oppositional views four paradigms can be described: functionalism, radical structuralism, neohumanism and social relativism. These paradigms also provide a way to identify and locate the basic similarities and differences between the dissimilar theories and underlying belief systems. The framework is a tool to map intellectual territories within Information System Development (ISD). Hirschheim et al. concluded that most of the methods of ISD have a lot of characterisations that can be positioned to functionalism: "*The research literature by and large continues to promote one paradigm: functionalism in ISD (comment: information systems development) and objectivism in data modeling. Moreover, if one looks at the textbooks on data modeling and IS development which form the basis of university teaching, they are virtually entirely functionalist in orientation (...) So the academic community perpetuates, consciously or unconsciously, functionalism. We teach it to our students (...) The students (...) apply it in practice. However in applying it to practice, it is likely that the shortcomings of functionalist approaches surface.*" (Hirschheim, 1995, p.46-54, p.237)



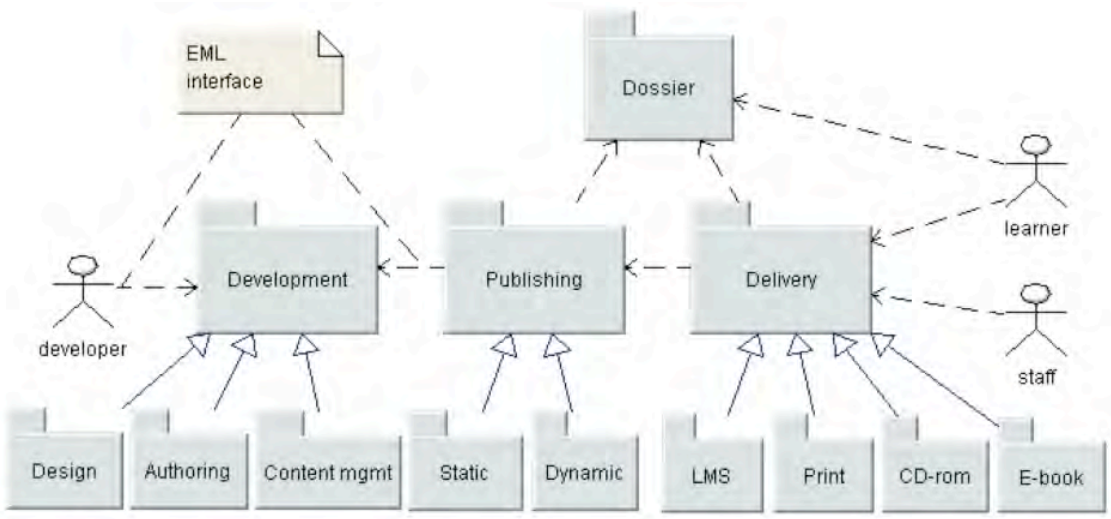
Methods of system design within the conceptual framework of Burell and Morgan

This position becomes more and more problematic because the main focus of Computer Science is not only the relation between data and information but above all the action and interaction of human beings with software, hardware and machines. An ICT-product is ready-made acting. By ICT-products such as mobile telephones, e-mail, groupware, workflow systems and Internet services, humans change their interaction options and, thus, the character and content of their interaction. ICT-products such as electronic banking, washing machines, interactive television, digital music have an impact on the behaviour, especially the daily routine of people. Therefore E-learning systems will influence the design of learning, and will influence learning itself: "*Functionalism insufficiently realized the nature and active role of language in the social construction of reality. (...) Practical applications of functionalism do not deal well with the ways in which humans create, negotiate and understand 'meaning'. (...) Typically they tend to define meaning as a correspondence relationship between real world objects and their representations*." (Hirschheim, 1995, p.109)
Functionalism is visible in Computer Science in the used oversimplified models of interaction and communication. From a technical viewpoint "communication" is perceived as the transmission of representations from a sender to a receiver through a neutral channel. The meanings of messages, the roles of sender and receiver are fixed and isolated from each other. The sender takes the active role and the receiver stays passive. In this models there is no room for negotiation or doubt in communication situations. The binary hierarchical opposition "sender-receiver" is the foundation for the opposition and distance in "subject-object" relations, in the actions "design" and "use", and in the vanishing of the subjective actor position in Informatics. Interaction and communication models have mostly just a technical and syntactical level but they are misused on a semantic and pragmatic level to construct planned and closed interaction. The semantic and pragmatic ambiguities, which occur in human interaction, are ignored. Ambiguity is seen as troublesome and inconvenient and thus has to be prevented and "dis-solved" at the technical and syntactical level. In models such as the transmission-model and the impulse-response-model there is no room for processes of meaning construction. Unfortunately producers and consumers of ICT-products focus too heavily on security and non-ambiguity, they are afraid of the complex and the unpredictable. Meaning construction processes have disappeared into processes of doubtless syntactical translation.
These poor communication and interaction models are embedded in most ICT-products, giving them the same intentions as a readerly[5] text. Its author (in the case ICT-products: designer or producer) is the autonomous, authoritarian producer, sender. The reader (user) is a prototyped passive consumer and receiver. ICT-models and -products are seen as reflections and projections of reality. The readerly (lisible) text gives to reader according to Roland Barthes: "*no more than the poor freedom either to accept or reject the text*" (Barthes, 1977)

---

[5] "*Roland Barthes referred to two kinds of writing in terms of the extent to which they involve the reader: the 'readerly' (lisible) and the 'writerly' (scriptible). Texts of the readerly kind (...) treat the writer as producer and the reader as submissive consumer and suggest their 'reflection' of 'the real world'. Texts of the writerly kind invite the active participation of the reader, and also, in their attention to linguistic mediation, an involvement in the construction of reality. . Ironically, it is readerly texts which tend to be described as 'readable', whilst writerly texts are often referred to as 'unreadable' because they require more effort. In passing, it is worth noting that the extension of Barthes's notion to other media could be productive, involving a consideration of the extent to which engagement with such media might be regarded as userly or makerly."* (Chandler, 1995)

Users have often only the very limited freedom either to accept or reject the ICT-products. Especially with ICT-products for learning learners don't have this freedom to rejecting because of the absences of alternatives, or the prescriptions in the imbedded learning scripts. Ironically, it is readerly texts that tend to be described as "readable", whilst "writerly" texts are often referred to as "unreadable" because they require more cognitive effort. (Chandler, 1995) The concept of "user friendliness" is based on the same notion of non-problematic interaction, doubtlessness and reliability of interaction. "Good" design is defined as making a product for users, which should not create disharmony or doubt in the life of the users. Easiness is equated to progress and to "user friendliness" (Markussen, 1995) As a "writerly" (scriptible) text invites the active participation of the reader; an involvement in the construction of communication, so an "actable" ICT-product should invite the active participation of the user, her involvement in the construction of interaction. Unambiguous and conflict free interaction of user and ICT-product, and silent transactions between interpretations and representations is suggested by many of the system development methods. Not the construction of differences and diversities, but streamlining and unifying is the objective. Out of this kind of perspective a lot of intractable ICT-products are produced for E-learning applications, too.



(Koper, 2001, p.7)

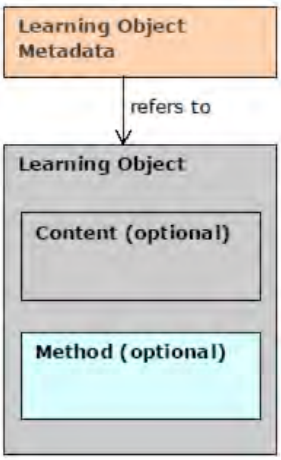
The communication model of the Computer Science is visible in the E-learning architectal model of Koper (Koper 2001, p.7) of which provides a conceptual view on the position of the EML (Educational Modelling Language) within an E-learning environment: In this E-learning architectal model there is (conceptual) distance in time and location between development and delivery, between developer and learners.

Of course most designers of E-learning think that the complete automation of learning material and learning processes is an illusive goal. Of course they think that not all dynamic aspects of human domains of activity, especially human learning, will be able to represent in a fixed structure of electronic units of study and electronic learning objects. Moreover, they do

not expect that all learners will give a uniform and by the developer intended meaning to any object .

But the harmonious cooperation between Computer Science and Instructional Design is grounded in the same epistemological and ontological roots as Jonassen concludes: "*Our instructional design models are grounded on two essential components of reality - objectivity and causality - both integral components of western consciousness. Objective reality is predicated on a number of assumptions, such as commonality of perception which supposedly enables us to observe and describe the physical world and to convey those descriptions to others as reality.*" (Jonassen, 1994)
Do we accept the opposition of "design and use": (E-learning) designer and user (students, teaching staff)? Gender projects about ICT use need to be critical of the underlying assumptions inscribed in the models of analysis, design, implementation and realisation (representations) of the ICT-systems which are transported into E-learning.
Gender construction in E-learning is finding and filling in the room between the oppositions of the planned learning with fixed rules and automated control, and the tacit, spontaneous learning with the flexibility of constructive acting. It is finding a balance between an unambiguous learning procedure and a creative learning process. It is giving the learner the possibility to design their own learning material by aggregating ready-made units of learning which are not based on conditional receiving caused by specialized learner profiles.

Learning objects - Potentiality and Limitations
One of the newest visions in E-learning is that of "learning objects" (Koper, 2001). They are estimated as building blocks for efficient computer based and interactive learning offers. The concept "learning object" is used broadly, but otherwise not specified in detail. The IEEE's specification IEEE "LTSC 2000" (The Learning Technology Standards Committee of the Institute of Electrical and Electronics Engineers) defines a learning object sparsely as being a digital or non-digital entity, which may be used and re-used, and which might be referred to by "metadata" before and during the technology-based learning. In the literature learning objects mostly are equated with digital entities, which are always available in the Internet in their actual version and are simultaneously usable by some various actors. Learning objects are stored in digital warehouses for development and distribution and will be re-used by many actors, helped by of metadata containing the stored entities' descriptions. Metadata are necessary for the actors (usually understood as students, teachers, administrators) to find and aggregate learning objects into complete courses. In this vision actors may be artificial too, e.g. a software process as an instance of an object class specifying some student type. This all assumes, that learning objects may be adapted or may adapt themselves to different student types, learning contexts, learning theories, models, levels, domains and cultures. The concept of learning object is rooted in the object orientation paradigm of informatics. Learning objects got their name, because their major attribute "re-usability" is derived from the architecture of object oriented software:



(Koper, 2001, p.4)

"*In principle learning objects have content (attributes and other learning objects) and descriptions of the behaviour of the learning object (operations). It is clear that the idea of a learning object model conforms to the principles of objects in the theories of object orientation. This also implies that principles of encapsulation, abstraction and inheritance may be present.*" (Koper 2001, p.5)

"*Learning objects are elements of a new type of computer-based instruction grounded in the object-oriented paradigm of computer science. Object-orientation highly values the creation of components (called "objects") that can be reused (...) in multiple contexts.*" (Wiley, 2000a, 2000b)

The paradigmatical object orientation background of learning objects must be deconstructed from a gender perspective.[6] Because one may expect, that critical comments from the gender analysis of the Informatics' object orientation paradigm will be relevant for the learning object vision of E-learning, too.

The method of object orientation (OO) was originally developed to implement systems of dynamically interacting (software) procedures (SIMULA). OO provides a formal language for the behavioural presentation of objects, which through their realization as software objects are ready-made for interaction. By specifying a fixed number of states and state transitions, and by describing all situational conditions for state transitions, it is possible to control an object instance's behaviour. The room for the interpretation of the acting, presented by the realized software object, is empty. The interpretation meaning is equal to the presentation meaning. The interaction among software objects results from their determined behaviour - so interaction processes are determined, too. Objects developed once cannot change their determined behaviour any more, because such behaviour is frozen into a software or hardware implementation, thus planned before use. This is effective for the object's internal behaviour for its interaction with other objects. Any interaction of objects is anticipated; unexpected interaction will result in a "breakdown". In the language of object orientation the determination of behaviour is supported by the "inheritance mechanism"; the "is-a-relation" allows to construct meta-classes (through generalization) and sub-classes (through specialization), using existing object classes: "*In object oriented programming the objects are encapsulated, that is they operate independently of the environment in which they are situated, and they respond in predictable and prescribed ways to the inputs which they receive. Thus this analogy, which is in perfect accord with the conduit metaphor, runs contrary to much of what we know about how human beings construct meanings from language, texts, images, etc. on the basis of their previous experience, which varies from individual to individual.*" (Griffiths, 2003)

In OO communication and interaction are modelled as causal sequences between senders and receivers, with links between message and reaction. Object oriented Informatics products are ready-made for a non-existant generalized "meta-user". Behavioural deviations of real users

[6] A detailed gender analysis of the OO paradigm in Informatics can be found in (Crutzen, 2000a, 2000b)

are to be moderated by specializations and feedback, ready-made and included in the product. All these are mechanisms to control the deviating behaviour of domains and users so that this behaviour does not move outside the obvious, the ready-made, and the ideal. The acting of learning humans is represented as entirely to be structured and pre-planned through so called learner profiles (models). The deployment of the method "object orientation" by developers of software objects and learning objects results increasingly in a detraction of the user's (learner's) room between acting and interpreting. The behaviour of learning objects is offered to the learners as determined and closed.
"*This idea seems to fit a specific conceptualisation of learning and of course design. It appears to propose that learning is about acquiring packets of information and that course design is only a matter of assembling units of content and packaging this together with a learning design template. This is more consistent with a transmission view of learning rather than a social constructivist view in which students construct their own interpretations of subject content in dialogue with others*." (Nicol 2003)[7]
In E-learning the learners should be allowed to use the e-material as a (planned) routine but it should be open enough to give them the opportunity to understand in which learning situations the ICT-representations are adequate and in which they should be abandoned. It is questionable whether the "object orientation" method and its products will enable a process of "Verlässlichkeit" (reliance), and whether the ready-made security will allow a negotiation process between the learner and the material. [8] When using object orientation for the analysis of learning situations and interactions in a critical fashion, one will observe that many aspects of human behaviour are not representable, because any attempt to determine the "changing of the change" causes a contradiction. The representation of social behaviour in groups also fails because for the object's interaction conflictfree harmony is assumed. So the "critical transformative room"[9]„ which exists in human interaction, cannot be represented with the method "object orientation".

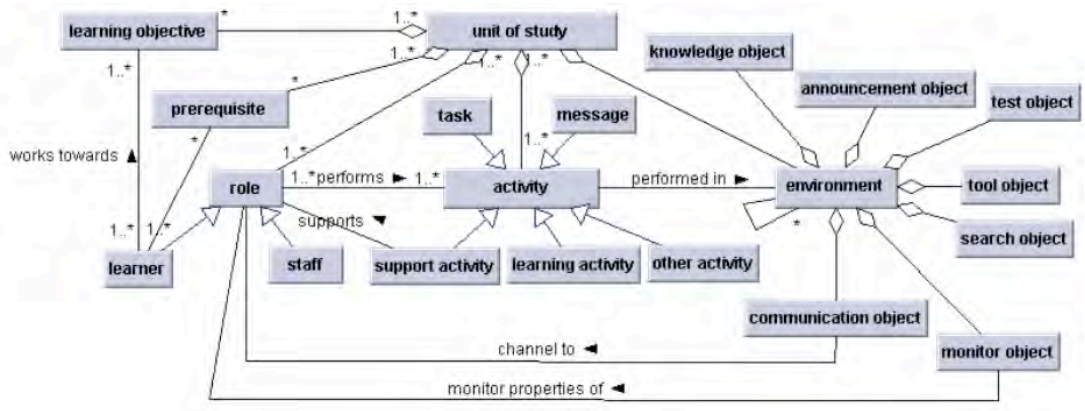
Object orientation software methods spread from software implementation into other domains. With products like UML (Unified Modelling Language) the domain analysis phase

---

[7] Another example of a critical approach by John A Finnis
„*Reusability, and in particular the topic of reusable learning objects, is the subject of much activity. The concept is attractive from an economic standpoint, but does not represent an educational panacea. Major criticisms of the approach are that it is too reductionistic and of compromising the quality of purpose-made content*." (Finnis, 2004, p.60)
[8] Heidegger calls this "Verläßlichkeit". He used it in two meanings: leavable and trustworthy (reliable) (Heidegger, 1936, p.28-29)
[9] By iterative mutual presentation and interpretation a room of potential acting is opened. Interaction among humans is a mutual presentation of acting. The presentation of acting triggers a meaning-constructing process in those actors, participating to the interaction.The percepting actor interprets the presented acting and realizes this interpretation by acting itself. The presenting actor interprets the impact of its own acting. All interpretation of acting is perceivable for others in the interaction of the participating actors through the actors behaviour and the changes induced. By iterative mutual presentation and interpretation a room of potential acting is opened. Stuart Hall states that a "meaningful discourse" already originates when a perceiving actor is able to construct an internal meaning (Hall 1980). Such a room is not conflict free, because presented acting might not be labelled exactly with that meaning, intended by the actor. If questioning and doubting activities is enabled, which might result in changes of routines and habits, then such an activity can be named as "critical and transformative" (Crutzen 2000b, 2003).

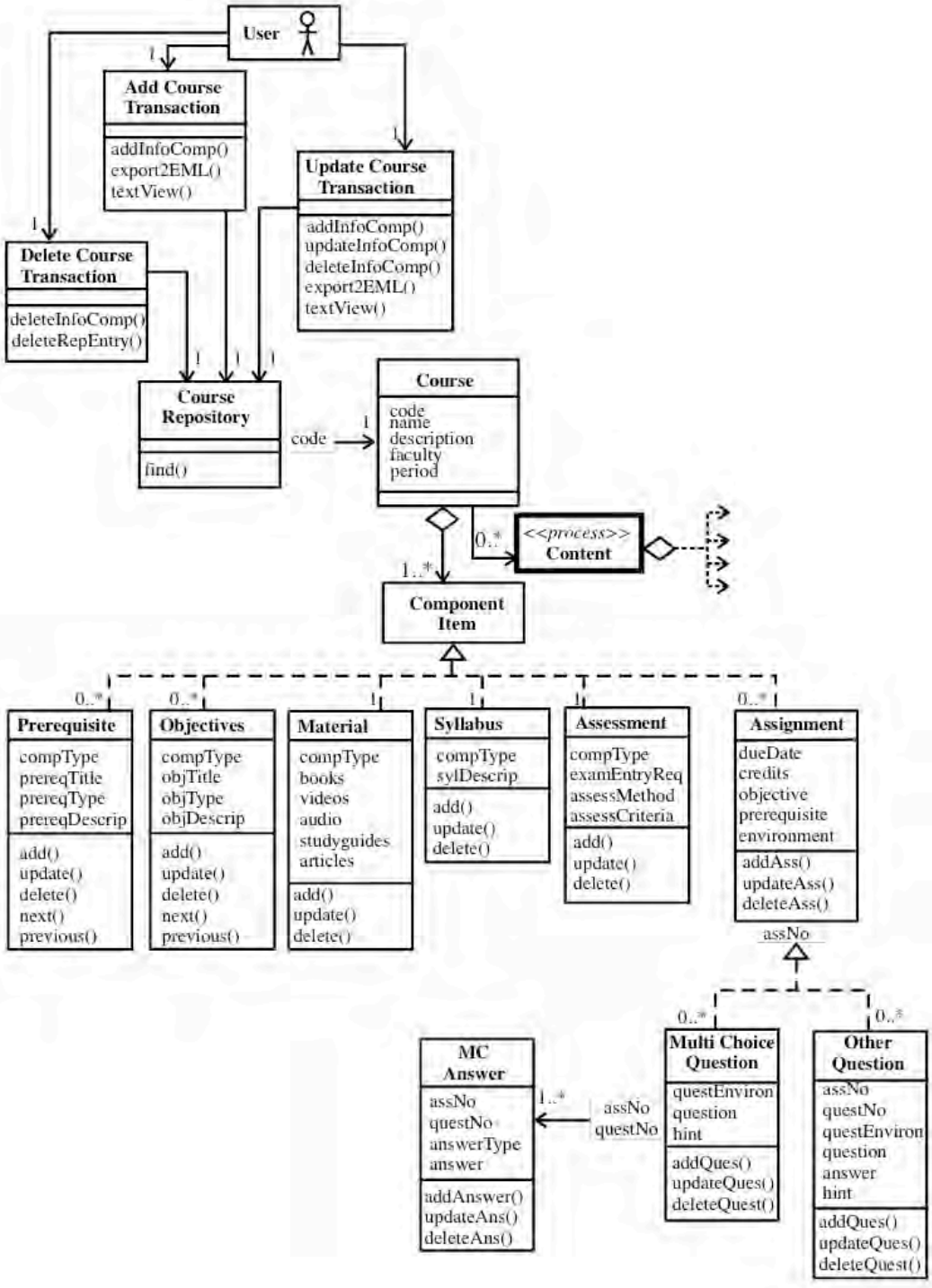
was colonized, in connection with a "replay of the past" when focussing onto the "re-use" options.
"O]bject-oriented techniques allow us to reuse far more than code. We can reuse requirements, analysis, design, test plans, user interfaces and architecture. In fact, virtually every component of the software engineering life cycle can be encapsulated as a reusable object." (Yourdan, 1996, p.6)
In E-learning this "colonization of the analysis phase" is evident, too. More and more UML representation techniques are used to analyse and describe learning and its situations. There from follows that in the learning object orientedness far to simple models for communication, interaction, acting, and meaning construction processes (in short: for learning) are employed. In Informatics this is a mayor cause for the separation and distance between design and use. The results of the deconstructive analysis of the object orientation paradigm in Informatics can be recognized in the way, the vision of learning objects is proclaimed. A typical example for the insufficient state of modelling learners can be found in the project IDEAL, which certainly refers to the complex aspects of learning, but then classifies learners only into five profiles:
"*The current set of skill levels as defined for IDEAL (intelligent distributed environment for active learning) are:*
– Beginner
– Novice
– Intermediate
– Advanced
– Expert" (Shi, 2002, p.240)

Increasingly the methods of modelling software are used for analysing and representing learning context and learning domains. As you can see out of the following statements and representations:



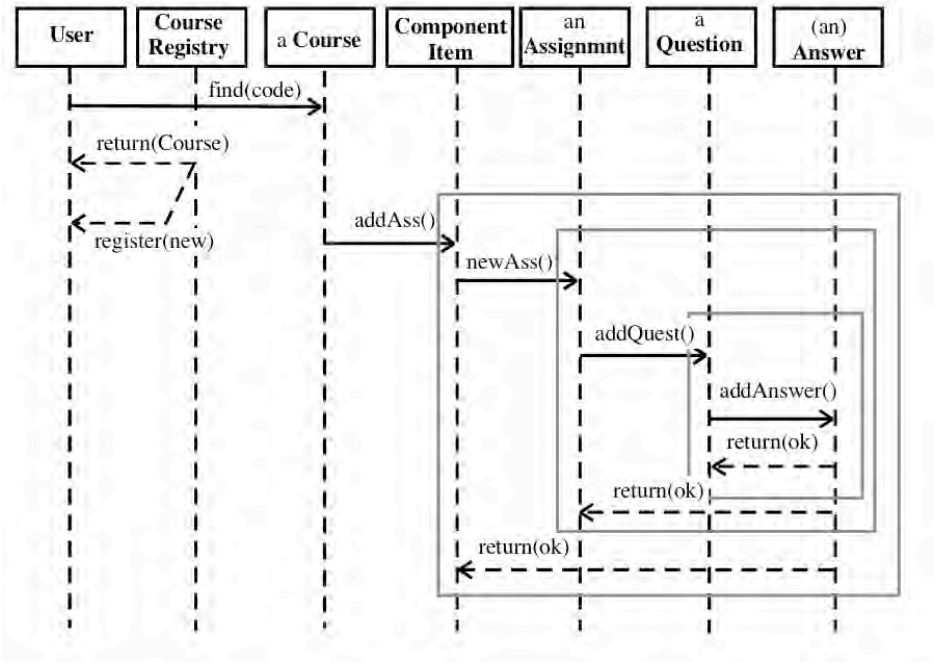
An example of learner model designed with a method for database modelling.

(Koper, 2001, p.11)



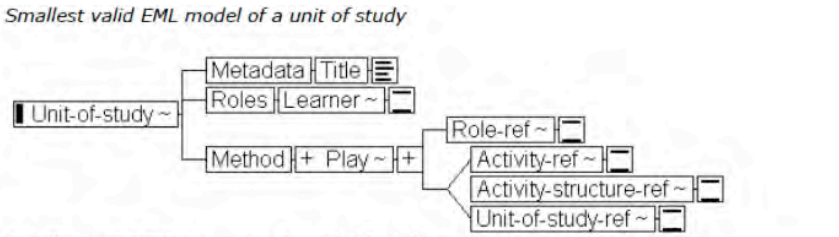
An object model diagram for the relations between the user and the course

(Cloete, 2002, p.11)



An interaction diagram representing the interaction during the assessment of a learner.

(Cloete, 2002, p.12)

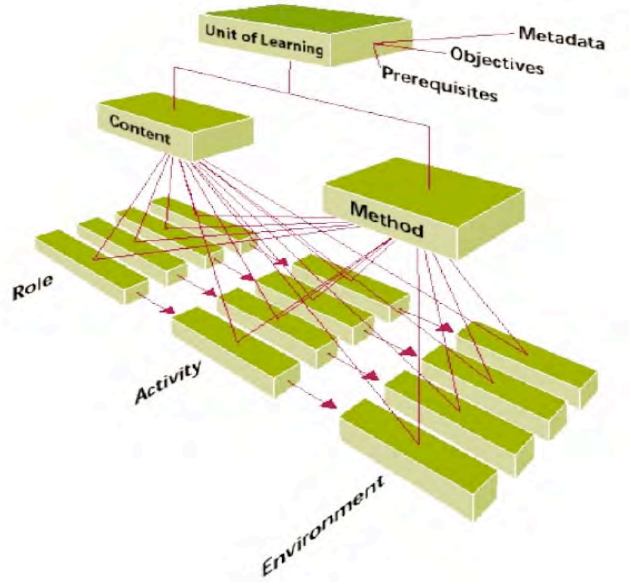


Smallest valid EML instance of a unit of study

```
<Unit-of-study>
  <Metadata><Title>Course on X</Title></Metadata>
  <Roles><Learner Id="learner"/></Roles>
  <Method>
      <Play>
          <Role-ref Id-ref="learner"/><Activity-ref Worldwide-unique-id-ref="default-student"/>
      </Play>
  </Method>
</Unit-of-study>
```

An hierarchical model of a unit of study,
represented in EML (educational modelling language)

(Koper, 2001, p.22)



The learner model implemented in a model for a unit of study

(Hermans, 2003)

The automation of the learning process of a learner is presented in a workflow diagram for the learning procedure of a learner.
Learner receives only learning material conditional if they fit in a pre-given learner model and if they have completed pre-given assessments successfully.

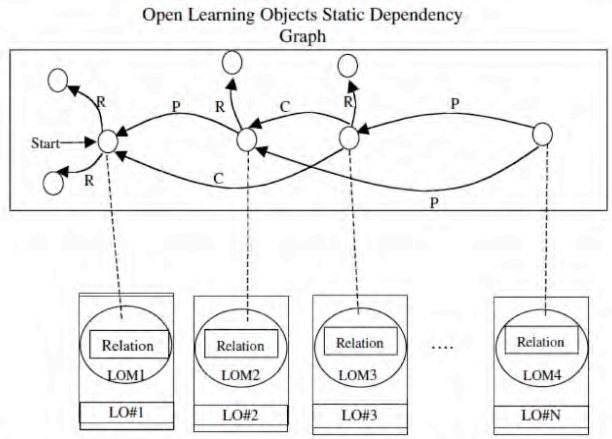


FIGURE IV.10.2 Using learning object metadata for defining a static dependency graph. P = prerequisite, C = Corequisite, R = remedial, LO = learning object, LOM = LoMetadata.

(Shi, 2002, p.242)

The aim of the complete automation of courses and learning processes with learning objects is illusionary, because not all dynamic aspects of human acting-domains, especially that of human learning can be represented in a structure of learning objects. In addition it cannot be expected that all learners will assign to each object a uniform and from the developer

presumed meaning. Wiley's warning (he indicates the colonization of E-learning through the concept "learning object" even as imperialism) should be taken seriously, because with learning objects the character of learning, its function of "self-change through situated meaning construction" is violated. The distance between teacher and student is increased, because the student's design of his own learning process is suppressed. It is reduced to a plain object usage, pre-planned by strangers: "*I am not alone in believing that the trend toward automated, adaptive, personalized, or intelligent systems, or in other words, the drive to remove expensive humans from the learning experience loop, is an insidious form of cultural or epistemological imperialism. We must be extremely careful that our learning environments based on reusable resources contain opportunities for meaningful discourse*." (Wiley, 2003)

Alternatives: Learning as Design

A different view on E-learning is possible, one which lets go of go the view of transferring knowledge packaged into learning objects, and instead sees learning objects as ready-made acting in form of computing tools. Jonassen designates these: "cognitive learning tools". He takes a quite radical point of view: "*Rather than using technologies by educational communications specialists to constrain the learners' learning processes through prescribed communications and interactions, the technologies are taken away from the specialists and given to the learner to use as media for representing and expressing what they know. Learners function as designers using the technology as tools for analyzing the world, accessing information, interpreting and organizing their personal knowledge, and representing what they know to others*." (Jonassen, 1994) To employ technology as a tool to support learning processes, challenges students to perform their own subjective constructions of knowledge and acting. Therefore it is essential to return the responsibility for the design of their personal learning and working processes to the students.

Through the gender analysis of object orientation in Informatics (Crutzen 2000a, 2000b) it is known that the diversity of and in learning objects only grows, if the answer to: "When, how, and by whom might learning objects be changed?" is given situated and not predetermined. If offered learning objects in their software form should keep changeable, three critical aspects with some options have to be considered:

- Instantiation of learning objects

  Learning objects have variable parts, in their passive content and in their active methods By the instantiation of the learning object these parts have to be resolved. Automatic instantiation of learning objects, e.g. based on a passive student profile should be avoided as much as possible. Instantiation should take place through interaction between teacher and student. Technology only should be supporting to keep the necessary parameter values consistent.

- Inheritance in learning objects

  Inheritance in software and learning objects is an operation to write over internal parts (content and methods) automatically and pre-planned. The "encapsulation" of learning objects has therefore to be unsealed. In software technology "re-use" is implemented preferably using inheritance. But inheritance has the disadvantage of introducing pointless pragmatical constraints between learning objects, when linking them syntactically into a hierarchical structure of meta-classes and sub-classes. For a learning object's user this rapidly becomes obscure, when unexpectedly being confronted with attributes and methods of unknown (inherited) learning objects, which where not requested. In this complexity caused by inheritance users have few options for changing anything.

- Aggregation of learning objects

  Aggregation is the "sticking together" of learning objects to build new learning objects. This operation should be possible for teachers and students before and during the learning process. It depends on the type of interoperability of learning objects, how easily they can be aggregated. In addition, aggregation includes the task of designing the needed interactions between the joined learning objects. Also a contextual frame for these interactions of the aggregated learning object has to be instantiated.
  For students and teachers the availability of aggregation can deal in many situations with the problem of learning object's granularity. If a learning object's metadata is documenting, which other learning objects have been aggregated and for which other aggregations this object has been used, then more new aggregations by other actors stay changeable and usable.

If ready-made learning objects contain closed determined acting, coupling could result in insoluble acting conflicts. It will depend on the learners and their learning situation, whether they can cope with this complexity of coupling. Although such interruptions in a learning process are not always disadvantageous - acting conflicts arising after an aggregation might be beneficial for the learning process itself. In a critical transformative learning room doubt and doubting is needed to induce changes in the learners' routines. During student's aggregation operations, teachers should be able to assist in the operation and in the selection of learning objects

Tom Boyle has given some useful design principles for making aggregation and reusability possible. E-learning material resources should act as small independent reusable objects. The users (learners and teachers) of aggregated (compound) learning objects should also have the possibility to decouple learning objects. (Boyle, 2003) Martin Weller et al. plead for a free availability of learning objects on the same basis as the Open Source movement. (Weller, 2003) It could create a very high motivation of both students and teachers for design and distributions of learning objects. As the Open Source movement has demonstrated this could lead to highly reliable usable learning objects.
Aggregation offers the possibility of including the situated human acting into the interaction of the learning objects. Thus a diversity of acting might grow during the learning experience. "Coupling" operations, student oriented "design patterns", and "pattern languages" seem to be future tools for learners to perform successful aggregation operations.

Brenda Laurel views software as a theatre script where the roles are played by the software objects (Laurel, 1993, p.17, p.20-21, p.44-45). Under this metaphor learning objects are a set of script elements for a learning play. In a thus partly ready-made theatre play (learning play) a human actor may perform four possible positions (roles): actor, spectator, director, and author. Brenda Laurel regards the software user's position as that of an actor in a play. Thereby she grants users a higher acting potential than simply the role of a passive spectator. But even in the actor's position human actors lack of room for negotiation, they have to act determined. Actors in a completely automated learning play can only behave within the interaction script of the learner type instance that is assigned to them. Only if the positions of director and author are opened to teachers and learners, can a critical transformative room emerge, where the learning play can be performed using the acting potential of the ready-made learning objects. Ready-made learning objects should have the openness to grant the director position to teachers and students before and during the learning play. It follows that

the autonomous performance of aggregating operations could be ingredient of the learning experience itself.

Conclusions

E-learning so far failed to be the all-inclusive medium for learning. One reason is that learners still are socialized in to perform successful learning in face to face learning environments. Also current E-learning products support much to rigid pre-planned learning processes, because it is not possible to represent and to offer all kind of learning activities in E-learning. So teachers as students prefer hybrid learning styles ("Blended Learning") to construct reliance based on own acting.
However the choice for "Blended Learning" often is justified improperly, reconstructing the duality between the cognitive and the behavioural components of human learning. Meaningful interaction processes, especially learning processes, are created by the interaction of participants and their experience with the ready-made objects in the process environment. The claim, communicative competencies could not be developed in E-learning environments follows from the conception that "the technological" principally is opposed to "the human" and "the social". According to Heidegger, the essence of the E-learning environment as technology is that it "unconceals" how much and what kind of social human acting is effective and efficient for learning processes. It makes, what became obvious in human interaction and learning, visible and perceptible again.[10].

One of the decisive trials for a constructivist and participative view of tuition and work in the discipline Informatics is of the design of the electronic learning and working environments itself. This depends on the future design of these environments, whether participative and cooperative learning and working for large numbers of people might be realized. The necessary condition is to research, design, and support cooperative and participative acting in the Informatics discipline, interdisciplinary[11], theoretically and practically. The product orientedness should be opposed to the reflecting on the development process, in order to see it as a social process, between people whose subjectivity and diversity should be concealed. "Use" and "design" should not be learned as opposite and separate, but integrated in cooperative and participative acting scenarios. Teachers and learners should be able to permanently renew their view on Informatics and to experience that developing Informatics products, as actable and negotiable for future users, is always situated. Exclusive individual learning processes, valued as most efficient by students, should be opposed to a team-oriented didactics, to develop social competencies. The advantage of compensating the pure syntactic and theoretical approach and methods with the semantics and pragmatics of these methods could be learned through the practical development and changing of their own E-learning environments to practice participative and cooperative acting in a real-life domain.
Openness in dealing with knowledge and ready-made acting can only grow, if learners are allowed to develop a problem orientedness in which the search for solutions in the supported

---

[10] According to Heidegger this is exactly what technology can bring about: "It unconceals, what does not bring forth itself (...) The crucial point (...) lies not at all in producing and handling, not in using the means, but in the referred unconcealment." (Heidegger, 1962, p.12-13)

[11] An example of an interdisciplinary course, an interaction between genderstudies, social studies and object oriented software modeling was given 1998 during the Informatica Feminale in Bremen. The schedule can be found at:
"www.informatica-feminale.de/Sommerstudium/Sommer98/Skripte/Crutzen_Vosseberg/Zeitplan.html"

content and the development of a web of relevant contexts is of more importance than giving an ultimate answer and solution.[12]

So what we learn from the gender analysis of E-learning in the domain Informatics, is:

- E-learning may with caution be enjoyed, if the learning is technologically supported, but not automated.
- Learning is the process of those who learn, not a procedure of those who teach or design.
- Learning is a process enabling those challenging questions, for which no ready-made answers exist.

References

Barthes, Roland (1977): "The Death of the Author". In: Graddol, David/Boyd-Barrett, Oliver (eds.) (1994): "Media Texts: Authors and Readers". Clevedon: Multilingual Matters in association with The Open University, p.166-170. Original publication: Barthes, Roland (1977): "Image, Music, Text". London: Fontana

Bødker, Susanne/Greenbaum, Joan (1993): "Design of Information Systems: Things versus People". In: Green, Eileen/Owen, Jenny/Pain, Den (eds.) (1993): "Gendered by Design?". Information Technology and Office Systems. London: Taylor& Francis, p.53-63

Boyle, Tom. (2003): "Design principles for authoring dynamic, reusable learning objects". Australian Journal of Educational Technology, 19(1), p.46-58, "www.ascilite.org.au/ajet/ajet19/boyle.html"

Brekel, Caroline/van Klaveren, Maarten/Tijdens, Kea (1999): The Absence of Women in the ICT-sector. "www.union-network.org/uniibits.nsf/0/0e6f44788232efd7c1256bd70040f070?OpenDocument"

Burrell, G./Morgan, G. (1979): "Sociological Paradigms and Organisational Analysis: Elements of the Sociology of Corporate Life". Heinemann, London

Chandler, Daniel (1995): "Texts and the construction of meaning", "www.aber.ac.uk/media/Documents/short/texts.html"

Clayton, B. Kaylene (2003): "Perceptions of IT and their influence on pre-tertiary students: An Australian study of gender and recruitment issues", "ecommerce.cit.gu.edu.au/cit/docs/theses/KClayton_Honours2003.pdf"

Clement, Andrew/Besselaar, Peter Van den (1993): "A Retrospective Look at PDProjects". Communications of the ACM, June 1993, vol.36, no.4, p. 29-37

Cloete, Elsabé/Kotzé, Paula (2002); "Reusable and Usable Environment for the Digital Courseware Domain". Informing Science and IT Education Conference, Cork, Ireland, "proceedings.informingscience.org/IS2002Proceedings/papers/Cloete171Reuse.pdf"

Crutzen, Cecile K. M./Vosseberg, Karin (1999): "Die Interaktion zwischen objektorientiertem Denken und feministischer Kritik – eine dynamische Verbindung". In: Björn Dreher/Christoph Schulz/Debora Weber-Wulff (eds.): "Software Engineering im Unterricht der Hochschulen (SEUH '99)". Stuttgart, p.149-165

Crutzen, Cecile K. M./Gerrissen, Jack F. (2000a): "Doubting the OBJECT World". In: Ellen Balka/Richard Smith (eds.): "Women, Work and Computerization: Charting a Course to the Future". Boston, p.127-136

Crutzen, Cecile K. M. (2000b): "Interactie, een wereld van verschillen. Een visie op informatica vanuit genderstudies". Dissertation, Open Universiteit Nederland. Heerlen

Crutzen, Cecile K. M./Hein, Hans-Werner (2001a): "Die bedenkliche Dienlichkeit und Sicherheit von Softwaresystemen und die erlebte Verläßlichkeit". 31. Jahrestagung der Gesellschaft für Informatik/Österreichische Computer Gesellschaft, Wien, Workshop "Erkenntnistheorie – Semiotik – Ontologie: Die Bedeutung philosophischer Disziplinen fürdie Softwaretechnik". In: Kurt Bauknecht/Wilfried Brauer/Thomas Mück (2001): "Informatik 2001. Wirtschaft und Wissenschaft in der Network Economy – Visionen und Wirklichkeit", Vol.II, Wien, p.782-787

Crutzen, Cecile K. M. (2001b): "Dekonstruktion, Konstruktion und Inspiration". In: FifFKommunikation 3/01, p.47-52

Crutzen, Cecile K. M./Vosseberg, Karin (2002): "Objekt-orientiertes Denken – Methoden erlernen unter einem kritischen Blickwinkel". In: Verein FluMiNut (ed.): "Proceedings 27th Kongress Frauen in Naturwissenschaft und Technik", 24.-27. May 2001, Wien, p.155-160

Crutzen, Cecile K. M. (2003): "ICT-Representations as Transformative Critical Rooms". In: Gabriele Kreutzner/Heidi Schelhowe (eds.): "Agents of Change: Virtuality, Gender, and the Challenge to the Traditional University". Opladen, p.87-106

[12] James Z. Li designates this "Search Learning and Matrix Learning" (Li 2000).

Finnis John A. (2004): "Learning Technology:The Myths and Facts". In: International Journal of Instructional Technology and Distance Learning, May 2004, Volume 1 Number 5, p.53-61,"www.itdl.org/journal/May_04"
Griffiths, Dai/Garcia, Rocio (2003): "Commentary on Rob Koper, Combining re-Usable Learning Resources to Pedagogical Purposeful Units of Learning". Chapter 5 in: Littlejohn, Allison/Page, Kogan (eds.): "Reusing Online Resources: A Sustainable Approach to eLearning". Journal of Interactive Media in Education 1, Special Issue on Reusing Online Resources,"www-jime.open.ac.uk/2003/1"
Hall, Stuart/Hobson, Dorothy/Lowe, Andrew/Willis, Paul (eds.) (1980): "Culture, Media, Language". London
Haraway, Donna J. (1991): "Simians, Cyborgs, and Women. The Reinvention of Nature".Free Association Books, London
Hermans, Henry/Manderveld, Jocelyn/Vogten, Hubert (2003): "Educational Modelling Language". In Jochems, Wim (ed.): "Integrated e-learning: implications for pedagogy, technology and organization". Routledge Falmer
Heidegger, Martin (1936): "Der Ursprung des Kunstwerkes". Used edition: Philipp Reclam jun., Stuttgart, 1960
Heidegger, Martin (1962): "Die Technik und die Kehre". Verlag Günther Neske, Stuttgart
Hirschheim, Rudy/Klein, Heinz K./Lyytinen, Kalle (1995): "Information Systems Development and Data Modeling". Conceptual and Philosophical Foundations. Cambridge University Press
Jonassen, David H. (1994): "Technology as Cognitive Tools: Learners as Designers". ITForum Paper #1, "it.coe.uga.edu/itforum/paper1/paper1.html"

Kirkup, Gillian (2002): "ICT as a tool for enhancing women's education opportunities; and new educational and professional opportunities for women in new technologies". United Nations, Division for the Advancement of Women (DAW),"www.un.org/womenwatch/daw/egm/ict2002/reports/Kirkuppaperwithrefs.PDF"
Koper, Rob (2001): "Modeling units of study from a pedagogical perspective - the pedagogical meta-modelbehind EML". Educational Technology Expertise Centre, Open University of the Netherlands, First Draft, Version 2, Juni 2001,"eml.ou.nl/introduction/docs/ped-metamodel.pdf"
Kramarae, Cheris (2001): "Why Women Go Online: Educational Plans, Preferences,and Aspirations". Part 2 of: "The Third Shift: Women Learning Online". Published by the American Association of University Women Educational,"www.aauw.org/member_center/publications/ThirdShift/thirdshift.pdf"
Laurel, Brenda (1993): "Computers as Theatre". Addison-Wesley, Massachusetts
Lawley, Elizabeth Lane (1993): "Computers and the Communication of Gender" "www.itcs.com/elawley/gender.html"
Li, James Z./Close, Richard (2000): "The Promise of eLearning and the Practice of Knowledge System Design". White paper, Leading Way Knowledge Systems, "www.leadingway.com"
Markussen, Randi (1995): "Constructing easiness – historical perspectives on work". In: Susan Leigh Star (ed.): "The Cultures of Computing", p.158-180
Merriënboer, Jeroen J. G. van (1999): "Cognition and Multimedia Design for Complex Learning". Open University of the Netherlands, inaugural address, www.ou.nl/otecresearch/publications/JeroenvanMerrienboer/JeroenvanMerrienboeroratie.pdf
Meyers, Wendy/Bennett, Sue/Lysaght, Pauline (2003): "Gender Equity issues in E-learning". Paper for International Conference on Network Universities and e-Learning. 8-9 May 2003, Valencia. Spain, "www.hsh.no/menu","www.upv.es/menuconf/CDMENUCONFERENCE/VirtualPoster/wendy_meyers.pdf"
Meßmer, Ruth/Schmitz, Sigrid (2004): "Gender demands for e-learning". Advances on Information and Communication Technologies, Vol.4, p.245-254
Millar, J./Jagger, N. (2001): "Women in ITEC courses and Careers". London, UK Department for Education and Skills, Department for Employment. The Women's Unit: 156
Monteith, Kirsteen (2002): "Gendered Learning and Learning About Gender Online, A Content Analysis of Online Discussion","www.odeluce.stir.ac.uk/docs/GenderedLearning.pdf"
Nicol, David (2003): "Conceptions of Learning Objects: Social and Educational Issues".Commentary on Duncan, Granularisation, chapter 2 in: Littlejohn, Allison (ed.): "Reusing Online Resources". Journal of Interactive Media in Education 1,"www-jime.open.ac.uk/2003/1/"
Oost, Ellen van (1991): The Process of Sex-Typing of Computer Occupations. In: Eriksson, Inger V./Kitchenham, Barbara A./Tijdens Kea G. (1991): "Women, Work and Computerization: Understanding and Overcoming Bias in Work and Education". Amsterdam: Elsevier Science Publishers, p. 407-421
Paquette, Gilbert (2004): "Instructional Engineering for Learning Objects Repositories Networks", "www-clips.imag.fr/calie04/actes/Paquette.pdf"
Seels, Barbara B./Richey, Rita C. (1994): "Instructional Technology: The Definition and Domains of the Field". Association for Educational Communications & Technology, Washington DC

Severing, Eckart (2003): "Anforderungen an eine Didaktik des E-learning in der betrieblichen Bildung". Perspektiven moderner Berufsbildung. Bielefeld, p.19–32. (Reprint in: Loebe, Herbert/Severing, Eckart (eds.):

"eLearning für die betriebliche Praxis". Wirtschaft und Weiterbildung, Vol.30. Bielefeld, p.67–80,"www.f-bb.de/f-bbv9/downloads/Anforderungen_an_eine_Didaktik_des_E-Learning_in_der_betrieb.pdf"

Shi, Hongchi/Rodriguez, Othoniel/Shang, Yi/Chen, Su-Shing (2002): "Integrating Adaptive and Intelligent Techniques into a Web-based Environment for Active Learning". In: "Intelligent Systems, Techniques and Applications". CRC Press Catalog Num.1121, p.229-260, "phoenix.lite.cise.ufl.edu:8080/dllsl/papers/BookChapter.pdf"

Virkus, Sirje (2000): "ICT, Open and Distance Learning and Gender". In: Mörtberg, Christina (ed.): "Where do we go from here? Feminist Challenges of Information Technology". Working Papers No.1, ITDG rapport, "www.luth.se/depts/arb/genus_tekn/ITDG_rapport3.pdf"

Weller, Martin/Pegler, Chris/Mason, Robin (2003): "Putting the pieces together: What working with learning objects means for the educator". For eLearninternational, Edinburgh, Feb 2003, "iet.open.ac.uk/pp/c.a.pegler/ukeu/edinburgh.doc"

Wiley, David A. (2000a): "Learning object design and sequencing theory". "wiley.ed.usu.edu/docs/dissertation.pdf"

Wiley, D. A. (2000b): "Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy". In D. A. Wiley (ed.): "The Instructional Use of Learning Objects", p.3-24, "reusability.org/read/chapters/wiley.doc"

Wiley, David A. (2003): "Introduction to Part 2 of Reusing Online Resources: Design Perspectives". Journal of Interactive Media in Education 1,"www-jime.open.ac.uk/2003/1/"

Yourdon, Edward/Argila, Carl (1996): "Case Studies in Object-Oriented Analysis and Design". Upper Saddle River, p.6
