

Business Game Learning Environment

Design and development of a competency-based distance education business curriculum at the Open University of the Netherlands

Paul Kirschner

Martin Valcke

Paul van Vilsteren

Open university of the Netherlands

Educational Technology Expertise Centre

P.O. Box 2960

6401 DL Heerlen

The Netherlands

email: paul.kirschner@ouh.nl

Abstract

The current approach to learning is based upon an educational system and paradigm that is supply-driven and course-based. In this paradigm, learning is offered in courses whose content, time, place and pace of delivery, method of delivery, and breadth and sequence of instruction are defined and stated by the course provider. Learning for tomorrow needs to be situated in study environments that are context-based and demand-driven. These environments must be flexible to meet the needs of learners, through adaptability to different learner needs, content, learning patterns and settings, and media combinations. Such flexible study environments enable learners to learn when they want (frequency, timing, duration), how they want (modes of learning) and what they want (that is, learners can define what constitutes learning to them). An environment to achieve such a distance education competency-based curriculum is being developed in the business sciences at the Open university of the Netherlands (OuN) as a collaborative effort with other more traditional universities and businesses in the private sector. This article is devoted to describing this **Business Game Learning Environment** (BuGLE). Along with a description of the premises upon which the environment is based, this article also describes the structure of a prototype which has been developed.

Keywords: just-in-time learning, gaming, simulations, learning environments, distance education

1. Introduction to BuGLE

The basic principle underlying on-the-job training, just-in-time learning and forms of experiential learning and education is that learning is more effective, efficient and meaningful if it is provided in a rich and relevant context. Cognitive psychologists increasingly emphasise the need for "situational learning" (learning in an experience-rich context) during practise, in which contextual information plays an important role. Interactive learning environments which resemble - to a large extent - authentic situations in which students can practise fulfil this need (Brown & Duguid, 1993).

It is the principle of context-based learning that BuGLE is based on. BuGLE stands for **B**usiness **G**ame **L**earning **E**nvironment. It is an attempt by the Open university of the Netherlands (OuN) to change the Business Science curriculum from supply-driven, course-based education to demand-driven, context-based study (Kirschner, Valcke, Hermans & Koolhaas, 1996). It is intended to be the 'flight-simulator' for our present and future business-pilots.

Learning and development is a never-ending-story in any professional career. Both labourers and academics need to continuously acquire new insights and techniques to support their professional success. New instruments and new problems require them to acquire and master new knowledge and skills. Flexible life-long learning is the answer to their needs and flexible life-long learning is the core business of the OuN.

The OuN is a fully accredited masters level university which is open to all persons above the age of 18, regardless of their educational background. As such, the OuN has a very heterogeneous student population of which a great number of the students has a prior higher educational and/or a professional background. The OuN allows its students a large degree of freedom with respect to time, place and pace of study in more than 20 multi-disciplinary graduate degree programmes in seven subject areas. Students study primarily in their own home setting although there is the opportunity to access the 18 study centres spread throughout the country. Traditionally, the OuN produced and delivered self-contained packages of printed learning material, augmented with electronic materials and personal tutoring. The development approach of these materials reflected a supply-driven paradigm towards education (Kirschner & Valcke, 1993). This paradigm is questioned in the context of the project described in this article.

The work presented here reflects the change process that has been adopted to implement the paradigm shift towards demand-driven education, of which the prototype elaborated upon is the first step in this process. The prototype has been used to involve faculty members and administrators in the project to promote thinking in terms of the new paradigm. The prototype has not been implemented with students, but is well beyond the planning stage being developed for use at the beginning of 1997 to realise a 250 hour study environment. Gradually, a growth scenario towards a 1200 hour curriculum and beyond is foreseen.

The Business Faculty represents one of the seven subject areas offering a number of degree programmes. Most students at the Business Faculty of the OuN do not intend to attain a university degree, but do so for other reasons. Middle-managers, aspirant managers or small entrepreneurs - for example - take courses to improve their performance in their profession. These students know what they want, because they have experienced a need for certain knowledge and skills in their work. Many of them are not interested in obtaining a course certificate; they simply need state of the art information on the subject at hand. They are in need of specific information (what is relevant to them) and not broad ranging courses (what is relevant to the instructor).

There is also a group of students who attend the OuN to obtain a university degree and are not (yet) working. These 'freshmen' - whose intentions are to become competent business scientist or managers - cannot imagine what it is like to cope with real business problems or effectively operate in a business environment. In the present situation they are 'handed over' to the institution. It tells them what to learn, how to learn it and why they have to learn it. Staff and course developers, guided by their own interests, are dominant. The abilities and interests of staff and course developers shape the building of individual courses, curricula and requirements around those interests. Therefore, the curricula are based upon the pigeon-holing of small, discrete subsets of knowledge into autonomous, fragmented and isolated courses and curricula. Teachers, according to Twiggs (1994) "have great latitude in organising courses, selecting teaching and learning materials, and making conscious [added by authors: and unconscious] decisions about how best to represent and communicate their evolving views of their academic and professional specialities. [Teachers] also select course materials for students based on highly individualistic judgements about such materials' educational value. Design all too frequently begins with the question, "What do I want to teach?" rather than, "What do students need to learn?". The concept of course design itself is indicative of a faculty-centred approach: faculty design, faculty select, faculty present. In the process, the student is often little more than a passive recipient of the outcomes of the faculty member's decision-making process."

What these students really need is to be placed in a broad, integrated and realistic setting where they are required to carry out specific tasks relevant to that setting and acquiring knowledge and skills relevant to those tasks when they need it. This setting should simulate the situation managers, entrepreneurs and business scientists are in as they do their daily work.

The OuN is developing a study environment which will place business students, beginning with freshmen, in a similar situation to practitioners. They will have to experience the impact and scope of managerial problems, the way things go in a business, the challenge to cope with competitors and organising their information and decision processes. Experiencing these real-life problems in a competitive game setting, students can discover their need for knowledge and skills. They choose their own training content and sequence in an environment provided by the institution according to their own experienced needs.

In BuGLE, business games have been chosen as the basis for creating real, life-like experiences. These are the heart of the learning environment and the catalyst for both making the students needs explicit and visible as well as for fulfilling those needs. This model of the education program supports the continuous development of the professional during his/her career based on providing continuous knowledge and skills of increasing depth and complexity as his/her career advances and as it becomes necessary and relevant. This implies that the boundary of the educational system is not defined by the milestone of a final exam or degree in one or more specific domains, but rather in the completion of specific criterion tasks as is the case in modern day assessment centres. There is also no time limit to the use of the educational system, all the more important for an institution such as the OuN for whom the market of life-long learning is essential for its future success.

The remainder of this article will be devoted to describing the design and development of Business Game Learning Environment (BuGLE).

2. Business: community, education and curricula

The business community has gone through a number of fundamental changes in the recent past. Organisations in the previous decades were best characterised by hierarchies, a focus on internal factors, remuneration based upon personal accomplishments, careers for life and individual competition. Organisations of the nineties, though containing many of the previous aspects, are - in addition - complemented by networks, focus on external factors, remuneration based upon competency, lifelong learning/learning for life and group co-operation. The following figure presents a number of salient shifts which are taking place with respect to business in the nineties as compared to business in the previous decades.

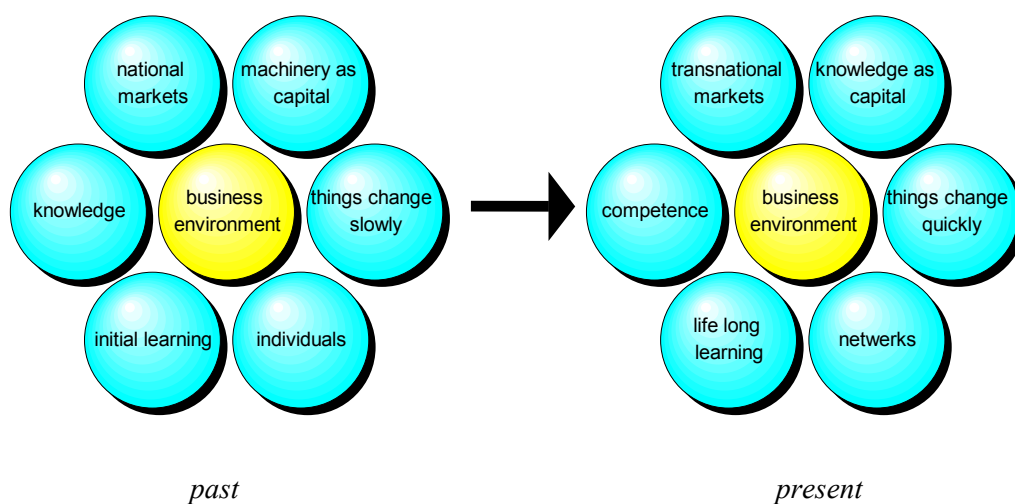


Figure 1 A comparison of business environments past and present

2.1 The nature of the discipline

The situation as it existed in the previous decades also had a direct effect on the structure and didactics of business - and for that matter all - education in that period. Executive power was based on formal authority, a large knowledge base, personal information access, personal networks, specific (management) skills and so forth. The management development programs designed and delivered in that period - and which are still being used at this time - concentrated on delivering large quantities of knowledge, and developing functional and analytical skills at the university level and on the acquisition of, often company specific, strategic and conceptual skills at the in-service level.

Education in the business sciences concentrates almost exclusively on imparting knowledge the way organisations function. Very few practical skills are acquired in business education. It tends to neglect such broadly acknowledged skills as:

- operating internationally with a good social and cultural insight into the differences between those societies and cultures,
- selecting essential data from large, ever increasing bodies of data
- interpreting, sometimes vague, signals that may be essential to an organisation,
- determining clear objectives
- acting quickly and decisively, sometimes under conditions of ambiguity and incomplete knowledge,
- being flexible in a flexible, quickly evolving world,
- adopting continuous, lifelong learning as a philosophy of management and of life, and
- working with others from a philosophy of commitment instead of in competition with others from a philosophy of detachment.

The present curricula in many university fields - and the place that business and management education has within them- fall short with respect to helping students acquire those competencies which allow them to function in an independent way based upon constant interaction with the wealth of policy choices available to them and confronting them and then adequately reacting to the consequences of those choices. This is a long, complex and time consuming process that is insufficiently represented in traditional education. Noted shortcomings are (see Hugenberg, 1992; Kirschner et al, 1996):

- inadequate structure both within the curriculum of business education as a whole and within the specific courses that make up that curriculum
- unavailability of valid maps of the different knowledge domains which make up the field of Management and Business Policy Sciences
- content of the curriculum and its courses are often out of date or tend to go out of date too quickly

- the forms of education used are not tailored to the needs of individual learners, but rather presuppose homogeneous mass audiences
- educational form and didactics are geared to the learning of facts, concepts, laws (declarative or substantive domain of the science: knowing what)
- graduates tend to fall short in their professional skills and attitudes (procedural or semantic domain of the science: knowing how - strategic domain: knowing why)
- testing and evaluation is primarily focused on facts and offer too little opportunity to measure the acquisition of skills and attitudes
- the techniques which students use to prepare for examinations stimulate and reinforce study strategies aimed at the reproduction of knowledge and not the competent application of it
- students lack shared organisational identities
- there is a notable lack of reality in assignments and when attempted is often a question of too little, too late
- the class is of too short duration to develop high levels of competence.
- there is a lack of clear direction in textbooks which seek to cover too much material while not allowing the necessary opportunity to gain skills and competencies.

2.2 The need for a change: From knowledge to competence

Most curricula concentrate on the acquisition of declarative knowledge and a few specific skills, but do not pay much if any attention to the acquisition of the necessary competencies to fulfil the roles the graduate will need to fulfil in her/his working environment. Before proceeding, a number of definitions must be presented. Generally speaking, knowledge can be characterised as ‘knowing that’, and skills as ‘being able to’. Here we will shortly elaborate on the definition of competence as ‘given a situation making the right choice and successfully carrying it out’ (see also Kirschner, Hummel, Vilsteren & Wigman, 1996)

Competencies pertain to a combination of the ability to choose and apply the correct knowledge and skills in specific situations and the personal qualities and attitudes necessary for learning about oneself and one’s way of acting. In other words, the user first has to know when to use a certain skill and why it should be used in that situation. Second, the user has to be able to be introspective and reflective with respect to his or her own actions to determine why things went the way they did or why they did not go the way they were planned. It requires situational learning so that the learner has the opportunity to constantly weigh different alternatives, make choices, evaluate those choices, perform the skill and evaluate and reflect upon its results so that the competency can be achieved and honed. The hierarchical or dependent relationship here is that no one can be competent without possessing the necessary and prerequisite skills and knowledge, but possessing those skills does not guarantee that a person is competent. It is, for example, not enough to perfectly carry out a discussion or meeting

according to a conflict model or a harmony model. Although someone who can do this may be highly skilled, he/she is considered competent only when he/she can demonstrate that he/she knows when and why one model should be chosen above the other and is also capable of carrying out the discussions according to that model.

What is needed, thus, is a new business sciences curriculum:

- which is problem oriented and ordered
- where thinking in processes is the central issue
- which is based upon just-in-time knowledge and skill acquisition
- which has a student centred approach to learning
- that can be easily and maximally updated
- that makes maximal use of prior knowledge
- in which social and affective aspects are integrated
- where there is a central role for competencies

3. An integrated systems approach to management education

Education comprises minimally five discrete, but interacting systems. These systems are the content or domain system, the didactic system, the social system, the administrative system and the technical system. In traditional education these systems usually do not interact or interface with other so as to influence each other and optimise the educational process. The assumption behind the design process of BuGLE is that these five systems should be functionally compatible and interrelated as represented in figure 2.

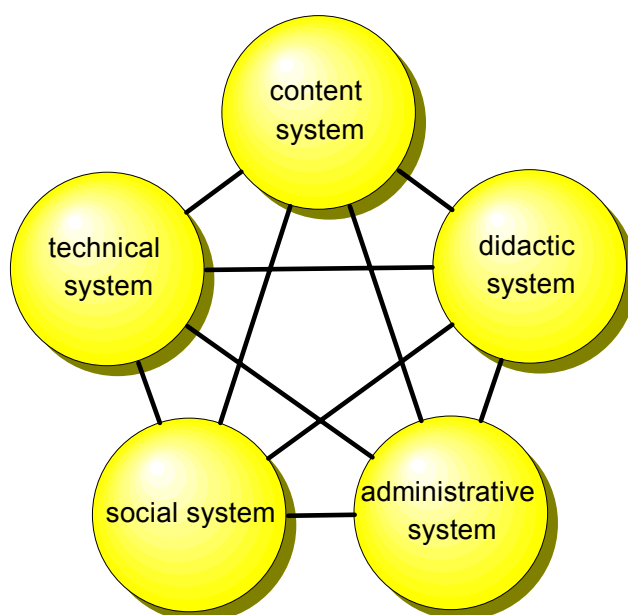


Figure 2 Interrelated educational systems

We first define and illustrate what is meant by each system. In the next part (paragraph 4) we show how this affects the elaboration of a BuGLE prototype.

3.1 Content system

The first step is the redefinition of the content system from a mass of fragmentary, isolated disciplines into an integrated description of that which is necessary to operate in a given field. For business science this is:

a social, and therefore a legal and financial system, that depends for its survival on generating sufficient income from the sales of products and services to independent customers.

This definition introduces us to the necessity to perceive and represent a business as a multi-aspect-system and as such requires the definition of its different aspects, namely:

- *Individual as actor* - Business cannot be seen independent from individual human behaviour. The employee is the basic element of the business system.
- *Transactions* - The business system interacts with its environment and the environment with it. Interaction takes place with other business systems through transactions which are confined by continuity constraints such as: You cannot exchange a physical object which you do not possess. The nature or content of a transaction is a consequence of the characteristics of the interacting units, and the means through which they interact.
- *Evolution* - There cannot be one specific detailed representation of the system that has applied and will apply to a business system over time. The changes in the system as a whole and in its parts are the consequence of the interaction between components and the changes induced by these interaction on the components themselves. The result of this is that the representation of the business system in the form of theories and models must also change over time. In turn this demands continuous learning by both the manager and the scientist as the systemic change processes create a continuous obsolescence of knowledge and experience. Consequence of the evolutionary character is that the scientific disciplinary contributions to our understanding must also continuously be under review, as must the functional disciplines within the field (marketing, human resources, logistics, . . .).

The systems theory approach to business and management dictates that all three elements are always part of the model at every level of analysis.

3.2 Didactic system

The second step is to formulate the ideas behind the proposed curriculum design. First, this curriculum will need to be designed with the student as its critical success factor. The study and learning processes (different categories of students are assumed, some of them demanding different approaches than others) form the backbone of the design. These processes should support the competence of a student to solve increasingly complex problems in the course of his/her studies and during the rest of his/her professional life.

The main assumption behind our didactic format for student centred business and management education is that the main problem to be solved is the motivation of the student to continually both widen the scope of his/her understanding of business and management issues and the depth of his/her knowledge of and *experience* with the fields of knowledge that support solving the inherent problems. Learners in BuGLE are exposed to concrete experiences that allow them to reflect on new experience from different perspectives. From these reflective observations they engage in conceptualisation, creating generalisations or principles that integrate their observations into sound theories. Finally, they use these generalisations or theories as guides to further action. Active experimentation allows them to test what they learn in new, more complex situations. The result is another concrete experience, but this time at a more complex level (Kolb, 1984, Kolb et al, 1991). The motivation and basis for the context is the challenging of the students to compete in a never ending series of business *games*.

The solution chosen for obtaining the necessary knowledge and skills within this experiential and competitive context is to learn while doing (*'just in time learning'*). When a learner needs information, advice or instruction quickly, he or she is able to obtain it on demand from an on-line knowledge system rather than trying to access it from his or her long lost memory or waiting to attend a class or seminar. The importance of when and where information is learned is well-established in psychological theory. Memory is highly context dependent (Tulving, 1983); that is, memories are more likely to be recalled if the context during retrieval matches the context during encoding. Thus, material learned during problem solving will be more likely to be recalled while solving future problems than material learned in a lecture environment. To this end, just-in-time learning allows and encourages access to learning materials, information banks, communication channels, and tools, so that the learner can call up the appropriate amount and content and type of learning material when it is necessary and useful. (Barker, Richards & Banerji, 1993).

The didactic system of BuGLE supports an information age pedagogical model where learning can occur anytime, anyplace, anywhere. The environment operates year-round; semesters and fixed class meetings will be a distant memory. Students can take as much or as little time as they need to complete the learning required and can access only those learning modules they find necessary, whenever and wherever they need them. Such a flexible, problem-induced, just-in-time learning will lead to:

- less time needed and lower expenditures for a particular training event

- better quality of results achieved, in that only the necessary content, in the most up-to-date versions, is chosen
- higher professional satisfaction, through less constraints relative to training deficiencies and more-adequate handling of professional tasks (Collis, Vingerhoets & Moonen, 1995).

The didactic system is primarily responsible for controlling the educational aspects of the game environment. As is the case with all of the other systems, the didactic system is strongly related to the other four systems and is partially dependent upon them for its functioning. The didactic system:

- is based upon competencies
- is based upon gaming and simulation
- contains just-in-time knowledge and skills
- is adaptive to learning style of the student
- is adaptive to prior knowledge and skills of the student
- is based upon the Kolb cycle of learning
- has study advice available¹
- is also aimed at achieving attitude change
- divides functions and roles within the business system among the students
- contains well defined educational and study products (based upon tasks)

3.3 *Social system*

The starting point for BuGLE is that all of the participants involved in the gaming process (students/players, staff, facilitators, Game Operator and Developer, and so forth) are part of a large social and educational network. The social system provides the opportunity for all of the participants to interact with each other in much the same way that they would within a business environment, virtual participants which are provided by the technical system, and ‘experts’ (i.e. more experienced peers, tutors, experts in the field) within the didactic system. As such, it supports interaction/communication on many different levels (one to one; one to many and many to many), both synchronous and asynchronous, between all of the actors within the environment.

The social system:

- has an open structure: a student can enter at any time
- is closeable

¹ The didactic system is capable of delivering different types of study advice to the student, namely: standard study advice and tips, personal, tailor made study advice and tips to each individual student, and - since the didactic system is interconnected with the social system - intervention by facilitator and/or peer students with specific, personal study advice and tips.

- allows a Game Operator and Developer to intervene
- is real (i.e. with respect to communication)
- allows for assessment by teacher and peers²
- makes (the products of) students objects of study for others
- makes (more experienced) students information sources for others
- supports briefing and debriefing

3.4 *Administrative system*

The basic element of BuGLE is the transaction which is the result of an interaction. Students interact with other students on an individual level, with other students in groups (teams), with tutors, with experts, with people in the field and with the environment itself, including with the Game Operator and Developer. Teams interact with each other and with the environment. The different systems within the environment also interact with each other. The administrative system of BuGLE must record this so that (actors in) the other systems can make use of the traces of the transactions (records) to follow the study process, make decisions on the basis of them (diagnose and/or prescribe) and finally to evolve and change.

Along with recording the transactions, BuGLE as a whole and the administrative system as separate system must be able to evaluate the transactions - in conjunction with the business and didactic systems - and act upon them. The actions taken by the other systems and the students themselves will affect both the students with respect to what and how they study as well as the environment with respect to how it adapts and evolves.

The administrative system:

- supports diagnostic and prescriptive student tracking
- records transactions
- orders and presents the transactions
- is selectively accessible
- is evolutionary / adaptive
- records which roles are/were filled and by whom
- Records which educational products are delivered

3.5 *Technical system*

² Students have access to assessment by teachers (tutors and/or experts) and their peers (fellow students, often with more experience, but not necessarily). The assessment by peers is not only profitable for the student being assessed, but also for the peer student who has to assess.

The system that is expected to support BuGLE is of a very complex nature since it combines features of a wide variety of existing approaches to educational technology applications such as: interactive learning environments, knowledge-based environments, computer-managed systems, student administration and registration systems, search systems, knowledge management systems, etc.

Basic features of the BuGLE to be designed and built are its database-features and its embeddedness in a distributed environment, thus requiring very stringent specifications in relation to communication facilities and access protocols.

In figure 3, we present a possible database-structure of BuGLE, building upon five dimensions, namely: competencies, task clusters, games, domain map and learning materials.

[insert figure 3 about here]

Figure 3 Structure of the B21 database

This database can be accessed from different perspectives, considering the roles of the following actors in the environment: manager/administrator, context specialist (curriculum developer, mentor, assessor) and student.

In relation to each dimension, information can be added to the database and/or relations with other dimensions can be made explicit. Dimensions are clearly interrelated. These interrelation are used when consulting the system. Dimensions 1, 2, 3 and 5 define the didactic system. Dimensions 3 and 4 define the business sciences system. Dimensions 6 through 8 define the administrative system. The way the database is accessed is defined by the technical system.

Considering the former, and taking account of the specifications that can be derived from the other systems, a number of basic characteristics can be put forward. The technical system:

- is object oriented (each database element is considered to be an object, with both attributes and functional behaviour; the behaviour of one object influences the behaviour and/or characteristics of other objects);
- has a database transaction log for students (the system documents all the interactions within the system);
- supports communication in real time (simultaneous/synchronous communication is possible between actors);
- has a central student administration database;
- supports just-in-time content and didactic information³ (students only access those materials which they consider to be relevant or necessary to the task at hand);

³ Solving tasks implies that students continuously have to check whether they master the underlying basic principles, theories, procedures, . . . that are explicitly stored in the database. Students trace the links from study or game tasks to themes/subthemes in the database and consult the learning materials in the database

- minimises communication costs for the student (asynchronous communication such as email, ftp, news groups, etcetera is also supported which implies that students do not need to be on-line continuously).

4. BuGLE

The interaction of the five systems becomes clear when considering a prototype version of BuGLE. Figures 4 and 5 show how a content specialist, in the role of a curriculum developer, builds a curriculum after defining competencies. Figure 4 shows how a task cluster is defined (setting up a company for the production and distribution of wind-up radios), with a unique link to a competency and how this cluster allows access to game tasks and study tasks. In figure 5, one can see how the developers define such a game task. Moreover, on the right side of the figure, the domain map and the relevant themes/subthemes are indicated which allow access to study materials or a list of references.

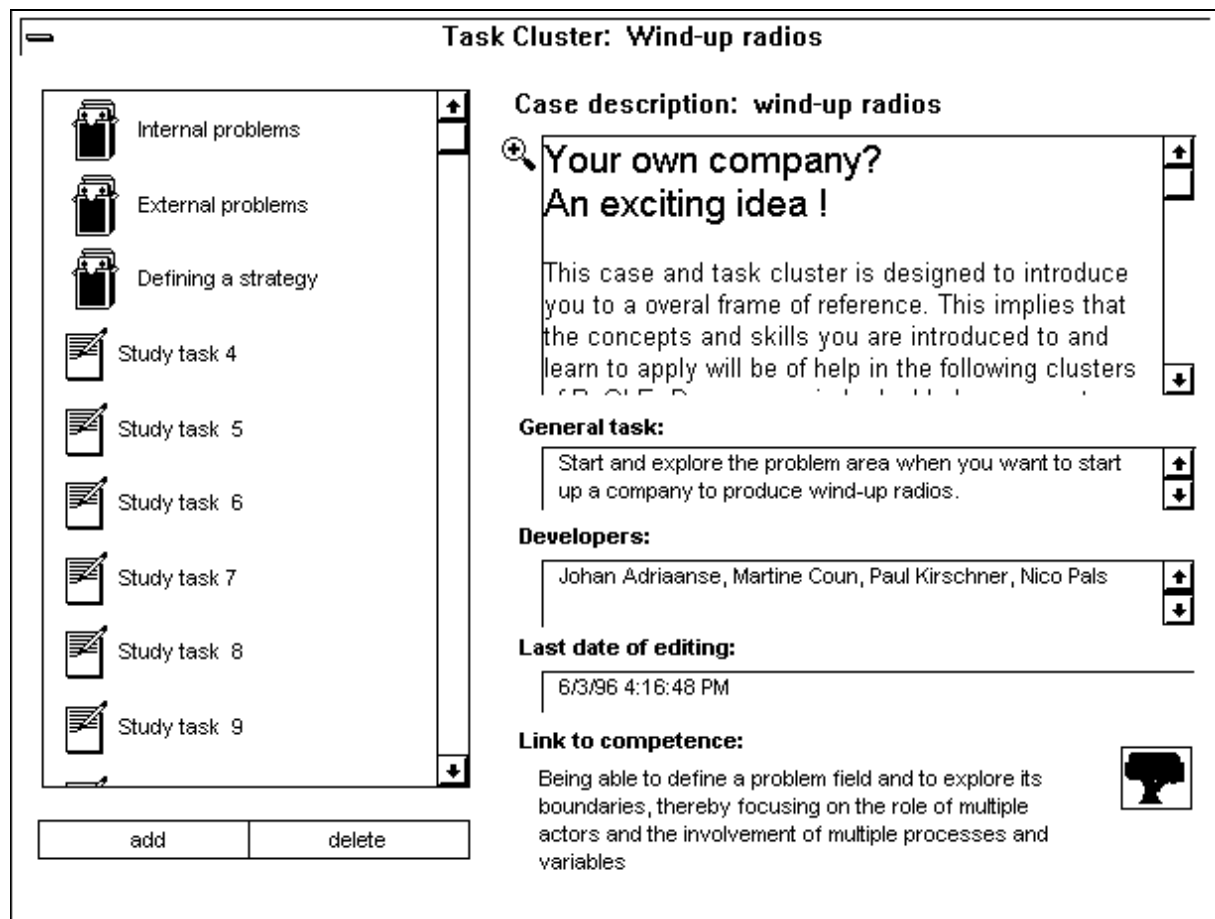


Figure 4 Definition of a task cluster

and/or check the references to learning materials. Here, the technical system can build on already existing systems that help to map knowledge domains and structure learning materials.

In figure 4, the following aspects of the environment (from the view of the content developer) can be seen:

- *case description*: the necessary background information/context for the task is presented;
- *general task*: that which the student has to carry out;
- *link to competence*: the competency that the task is aimed at achieving is linked to the case and the task;
- *game task* (deck of cards): the criterial tasks that must be carried out by the student to both attain and prove competence;
- *study task*: those tasks deemed facilitative to the achievement of the necessary prerequisite knowledge and skills for carrying out the game tasks.

Task Cluster Wind-up radios - Internal problems

Name of task: Study load: hours

Type of task: Study task Game task

Task:

Evaluators: Content specialists:

Developers:

Competency: Being able to define a problem field and to explore its boundaries, thereby focusing on the role of multiple actors and the involvement of multiple processes and variables

Is linked to skill:

Evaluation criteria:

Link to themes:

Domain map:

Themes:

Figure 5 Definition of a game task within the task cluster 'Wind-up radios'

In figure 5, the following aspects of the environment (again from the view of the content developer) can be seen:

- *type of task*: as stated, a task can be either criterial (game task) or facilitative (study task); here the link is made;
- *task*: the specific task which the student should carry out;
- *competency / is linked to skill*: here too the link is made between task and competency (and the thereby prerequisite skills and knowledge);
- *evaluation criteria*: the indicators for success, necessary for the development of the domain map, the tutoring and evaluation of the student and the carrying out of the task by the student;
- *link to themes*: here the task is linked to the domain map and the therein relevant themes and subthemes in the content system necessary to achieve just-in-time learning.

Both figures clearly illustrate how, from the perspective of the content specialist, the five major dimensions of the database are filled and interrelated. One can easily imagine what the perspective of the student will be when he/she enters BuGLE. With respect to the administrative system, students will receive support at the level of their study progress (the system logs transactions within the environment with respect to all study activities), they receive feedback in relation to the work completed (this feedback is provided by the system itself, the tutors and/or the experts) and they have access to a variety of tools (email, FTP, news, standard applications such as word processors and databases and specifically developed tools), for example, to contact peers, experts/content area specialists or tutors (social system/didactic system) and to facilitate the carrying out of the tasks (applications and specific tools).

BuGLE offers a solution to the problem of helping students attain the necessary competencies both based on and building upon a curriculum in which management gaming plays a central role. The system is based upon a series of management games whose complexity increases and whose knowledge domain focus changes in the course of the curriculum. The games are linked to maps of the different knowledge domains belonging to the Management and Business Policy Sciences as well as upon a series of tasks or problems within/across those domains which students must complete or solve. These tasks are also the ‘certifiable units’ of the curriculum. In other words, in a best case scenario, traditional examination as we know it would be eliminated. Components of the solution are:

- the use of guided independent study
- mapping of the different knowledge and skill domains and their sub-domains within the area of Management and Business Policy Sciences
- restructuring the domains into a consistent set of themes and subthemes
- using games as the central didactic technique for the acquisition of knowledge, skills and attitudes
- ordering of the games is based upon the chosen structure of the domains
- task clusters. building upon the games, give direction to the study

- the successful completion of tasks in the task clusters (game tasks and study tasks) is certifiable
- the successful completion of all task clusters is certifiable for the acquisition of the therefore defined competency or diploma.

4.1 Games

Games are complex representations of reality with a wide range of possibilities. A game is a dynamic representation or model of the reality in which people, in different roles have great influence on the parameters of the model. While a simulation always reacts in the same way to a specific intervention or action, the outcome of an intervention in a game is partially unpredictable because it is influenced by the specific behaviour of the actual players. Generically speaking games are “contests (play) among adversaries (players) for an objective (winning, victory, play off)” (Bryant & Corless, 1986).

A *business or management game* is generally a simulation of a business scenario. Within this scenario groups of players (decision makers) interact within a prescribed setting constrained by a set of rules and procedures. The behaviour and interaction is such that teams often compete against each other by running simulated organisations. However, within a game setting they may also co-operate, conflict or even collude with each other (Hsu, 1989). The players in the game and working as a team often have to adopt particular (management) roles, make decisions, review the results of those decisions and then make new decisions based upon the new situation. This often lasts a number of periods or cycles upon which the game ends and a winner is declared (Burgess, 1989). It is not always necessary to have winners and losers in a game, but this mechanism is often used to increase the incentives for the players in taking part in the game.

A game presents a real life situation where students must try, given a problem description and the necessary case or background material, to solve a problem in a situation where one can win or lose and where the degree and margin of winning or losing depends upon their actions. Game contexts can take on three forms, namely:

- independent simulation for the acquisition of (partial) skills. This may be likened to a ‘bridge tutor’
- independent gaming where the student can play any of the roles within the game. This is primarily for the integration of the partial skills into more complex skills. This may be likened to a ‘bridge computer’.
- group gaming, either in a real time or delayed context (Mail chess) and either in a face-to-face contact or a computer mediated situation.

According to Doyle (1996) some of the most effective cognitive tools are computer simulations that are used to train people to operate complicated technical systems. These simulators allow the operator to gain experience dealing with situations that are rare or that are too dangerous, costly, impractical, or

even impossible to reproduce in real life. These techniques are now being adapted to aid learning and social problem solving in fields such as economics, management, government, and environmental science. This "system dynamics" software has been successfully used to help experienced managers, college students, and even grade schoolers improve their ability to understand the behaviour of complex systems by "managing" simulated businesses, economies, and ecosystems. According to him, the advantages of learning in simulated "virtual worlds" or "microworlds" are:

- they allow controlled experiments to be done easily and quickly, so that the effects of possible causal variables can be teased apart,
- actions taken in them are reversible, making it easier for students to learn from outcome feedback,
- time is compressed so that students receive feedback more quickly,
- they can be interrupted, allowing more time for reflection before committing to a course of action,
- they force people to make their mental models of the world explicit.

Considering the specific focus of task clusters on a specific competency, it is important in BuGLE that the input and output of the games is under control. Students are positioned in the game setting and are confronted with specific pre-set values and conditions. Participants enter a working model of reality which provides the opportunity to experiment. Participation is not imaginary, but real in the sense that simulations and games present learners with choices that have to be made and the results of those choices. The individual learner's experience is an experience of discovery, of learning about the reality being modelled by exploring it. Its instructional value lies in the transferability and applicability of the choices made to other life activities and their behavioural choices therein. This can be called the validity of the simulation or game (Lederman, 1994).

Much of the learning from a simulation or game takes place through processes of reflection (Kolb, 1991) after the experience rather than during it. Long after the participation is over learning continues to take place. In this respect it is critically important to help participants to process what they have experienced. This is the function of debriefing. In the educational experience, the purpose of debriefing is to use the information generated during experiential activities to facilitate the learning of those who have experienced. In this context, debriefing helps the participants to learn from their experiences by processing those experiences effectively.

Along with debriefing, reflective behaviour is also stimulated by the specific game or study tasks put forward in the task clusters. A facilitator must "guide the learners in processing their experiences, leading them through the necessary reflection that will engineer understanding that can be applied to real-life behaviour and experiences" (Lederman, 1994, p. 219)

A problem with games in education is that they are often used after students have gained a certain amount of declarative domain knowledge to allow them to allow them to acquire certain (partial) skills

in a simulated setting. They are often at best complementary to traditional expository teaching expected to encourage 'active learning'⁴ and the chance to learn and hone skills. In BuGLE, as shown in figure 4, the student has just-in-time access to real life experiences as well as to key themes/subthemes and related study materials. Learning in the context of such an environment should become the dominant mode of education in the 21st century (Forrester, 1994).

4.2 Structure of BuGLE

To the curriculum developer, the competencies are the primary and binding elements of BuGLE. To the student, games are the binding elements of the curriculum and guide/determine the flow of the study. At the beginning of the study, the games are simple and are primarily aimed at the acquisition of specific skills and knowledge and their application. As students progress in their study, the complexity of the games increase accordingly (for example a game with a local context will gain a national and then an international context) or are replaced by another game with a different context, goal or domain.

Each game is related to one or more key themes/subthemes that are in a many to many (m:n) relationship to competencies. This means that more than one competency can be related to more a number of themes/subthemes, or that one theme/subtheme can be related to a number of competencies. Within each game, the key themes help the student to access specific declarative, procedural and strategic knowledge that are part of the knowledge and skill domain of Management and Business Policy Sciences.

To compose such a curriculum the structure of the whole domain, as well as of the sub-domains, are mapped in a consistent, complete and valid way. In other words, there is a representation of the knowledge domain. In the database structure, described earlier, the domain map is the explicit representation of this knowledge domain. This knowledge domain representation gives the relationship between the themes and their subthemes within the domain of Management and Business Policy Science. All of the necessary knowledge (declarative, procedural, strategic) is ordered and related within the representation. The Educational Technology Expertise Centre at the Open University of the Netherlands has developed a tool to do this within the Interactive Learning and Courseware Environment (ILCE) project (Valcke & Vuist. 1995; Valcke, Martens, Portier & Weges, 1996). The tasks within the games point to the themes and subthemes within the different domains.

Every theme or subtheme within a knowledge domain representation is specifically related to learning materials (references or readily available as electronic files). This material is made up of basic materials enriched with support elements whose goal is the facilitation of the study process. Examples

⁴ This seeming dichotomy between active and passive learning is actually an impossibility. Learning is by definition active. Facts, concepts, theories, skills are actively learnt, actively assimilated into the knowledge base of the learner and the knowledge base actively accommodates itself to the new information and/or skill.

of such elements are: examples, cases, simulations, illustrations, references to other themes and subthemes, and tasks.

Study progress in BuGLE builds upon tackling consecutive task clusters related to the games. The clusters (composed, as stated earlier, of game tasks and study tasks) form a proper and useful organisational element in which the effective factors of mastery learning and the available educational infrastructure can be placed in a proper perspective and can be utilised in an effective and efficient manner. If preferable, the tasks can be organised according to traditional semester or trimester units. It is not necessary to pre-define all tasks that students need to complete. A task can just as well be limited to the presentation of a frame of reference within which students can and must define their own tasks. By carrying out a task, the student takes a step in learning towards the acquisition of a competency. Tasks:

- have concrete aims and are well defined
- have a preferred product, a clear and unambiguous norm and clear/understandable criteria with respect to the quality and quantity of the product
- are intellectually challenging
- have a reasonable size
- are related to more than one learning activity; that is they are integrative
- are divides or are divisible into sub-tasks with a responsible didactic task structure
- contain practical and useful study/solution tips/hints, advice, etcetera for the way in which they could be accomplished
- contain ideas as to where the necessary declarative or procedural knowledge can be obtained and how this knowledge can best be used
- have logical and didactic relations to other tasks
- give practical advice as to the carrying out and handing in of the tasks
- can - within certain restraints and limitations - be defined and carried out by the students themselves
- form the basis of testing through entry testing, progress testing and certification testing; a certification task for one theme is often the entry test for another.

4.3 Student/game scenario

BuGLE can be used at three different levels. Level 1 of BuGLE is a simulation environment. At this level, the student interacts in an individual mode only with her/his computer in a simulation of a business environment or with a tutor via the available social and administrative systems. At level 1, the model at the Centre of the oval (see figure 6) controls how the simulation will react to student actions. The reactions of the environment are predictable in terms of the model used and one of the goals of the study process - at a fairly high level - is for the student to learn to understand the model

and work with it accordingly. Eventually the student should be able to alter the model to suit different situations.

At level 2, the first game level, the student interacts with other students and groups of students. She/he plays a role, makes decisions and interacts with the model based upon those decisions. Groups of students (teams) interact with each other. The reactions of the environment to student actions is here too governed by the model. The response of the system is thus predictable and again a goal of the study process - at a fairly high level - is for the student to learn to understand the model and work with it accordingly.

At level 3, the second game level, the student continues to interact with other students. The difference with level 2 is that here it is no longer the model which governs how the system will react, but rather the actions of the different groups of students which create the dynamics of the environment. The model is replaced by the group's own dynamics. The reactions of the environment are no longer predictable.

5. Conclusion

In education, but first and foremost in the workplace, there is an increasing interest in more-flexible training and professional education. This move is motivated by a number of different complementary forces that are economic, psychological and educational in nature. Arnett (1993) citing major corporations calls the concept of workplace-based, just-in-time learning, when and where you need it a "Paradigm shift for the Year 2000". In engineering education, Kenyon (1993) proposes a "New Paradigm for the 21st Century," where, in his words "every undergraduate program of study in engineering should include at least one significant experience wherein students are exposed to the concept of open-ended problem synthesis and solution while working as part of a broadly structured interdisciplinary group."

The goal of tomorrow's education shifts from the transfer of knowledge to the acquisition of competence. Students will resemble today's research faculty and will possess qualities of increased independence and self-reliance. No longer will students be passively taught by teachers who organise the learning experience for them. Students will learn how to find and use learning materials that meet their own individual learning needs, abilities, preferences, and interests; they will learn how to learn. (Twiggs, 1994). Educational institutions will, thus, produce graduates who are more adaptable and flexible thinkers, who are generalists that can transfer knowledge and insights across academic disciplines. To achieve this, curricula will need to be re-engineered, not simply by designing and developing interdisciplinary courses, but rather through the use of cognitive tools such as knowledge systems, system dynamics software and virtual worlds which are ideal for accessing just-in-time

knowledge and skills and aiding transfer of learning by making it possible to access, visualise, understand, and compare the structure and dynamics of complex systems in the light of their underlying knowledge domains.

In this article we described the basic concept of BuGLE, the **Business Game Learning Environment**, as an environment to achieve just such a distance education competency-based curriculum in the business sciences at the Open University of the Netherlands. The major principles of this curriculum are context-based and demand driven.

In demand driven education "the student is the principal arbiter in making judgements as to what, when and how learning will occur. Typically, students not only select and sequence educational activities, but identify, create, cultivate, pursue, and satisfy their individual learning needs" (Hannafin, 1992, p.54). In a demand driven curriculum development will begin by asking what students need to learn. In such an environment factual information will be only rarely presented in lecture form. Instead, information is acquired, studied, and applied as it is needed for problem solving. To borrow Reinhardt's (1995) terms, in the future "just in time" education will replace "just in case" education. Through a process of individualised assessment, we will find out what students already know and how they learn best. Assessment will be both holistic--comparing where students begin in relation to the outcomes needed for the degree--and particular--repeating the process for the skills and knowledge needed for specific subject matters. Vast quantities of information and learning materials will be easily accessible via the network. Learning materials will not be course based, but, rather, will be modularised to respond to individual learning needs and preferences. Materials will be delivered in a variety of formats depending on the individual's learning style. Evaluation of student learning will be an integral part of each set of learning materials, thus eliminating much of the labour-intensive grading process. (Twiggs, 1994)

The very heart of BuGLE will be the series of business games and simulations. Participation in a simulation or game is an experiment with a simulated reality. This participation has important implications for the learning environment. Simulations that involve people in face-to-face interactions with one another go beyond simple models in that they are comprised of the same materials (people, behaviour, social phenomena) as their real-world counterparts. And, as is the case with their real-world counterparts, once created and set in motion, the behaviours exhibited by the participants are real behaviours (Lederman, 1994). If we succeed in creating this simulated reality as the catalyst of students needs for knowledge and skills as well as the environment for assessing their competence, then BuGLE can be an important example for the redesign of the Open university of the Netherlands and for other institutions of higher (distance) education.

A prototype of BuGLE is being implemented and will be tested with students in a variety of settings. It is expected that the outcomes of the experiments will be helpful in validating our premises and expanding its operational elaboration in new and larger versions of BuGLE.

6. Literature

- Arnett, B. (1993). *Education and human development at future workstations*. Paper presented at TeleTeaching 93, Trondheim, Norway.
- Barker, P., Richards, S., & Banerji, A. (1993). *Case studies in electronic performance support*. Paper presented at AI-ED 93: World Conference on Artificial Intelligence in Education, Edinburgh, Scotland.
- Brown, J.S., & Duguid, P. (1993) Stolen Knowledge. *Educational Technology*, 33(3), 10-15.
- Bryant, N. & Corless, H. (1986). The management of management games. *Simulations/Games for Learning*, 16(3), 99-111.
- Burgess, T.F. (1989). The use of computerized games in business studies. *Educational & Training Technology International*, 26(3), 226-238.
- Collis, B., Vingerhoets, J. & Moonen, J. (1995). *Flexibility as a key construct in European training: The Telescopia project*. <http://www.dipoli.hut.fi/org/TechNet/telescopia/materials/si2.html>.
- Doyle, J.K. (1996). WPI - *The next 25 years: Educating techno sapiens in the 21st century*. <http://www.wpi.edu/~thkeil/jd.html>.
- Forrester, J. (1994). Learning through system dynamics as preparation for the 21st century. *The Creative Learning Exchange*, 3 (3), 1-8.
- Hannafin, M.J. (1992). Emerging Technologies, ISD, and Learning Environments: Critical Perspectives. *Educational Technology - Research & Development*, 40 (1), 49-63.
- Hsu, E. (1989). Role-event gaming simulation in management education. *Simulation & Games*, 20(4), 409-438.
- Hugenberg, L.W. (1992). Simulations as a fundamental teaching tool: Striking the appropriate balance. *The Bulletin*, December, 65-69.
- Kenyon, R. A. (1993). The coming revolution in engineering and engineering technology education: A new paradigm for the 21st century. *Education*, 113 (3), 361-371.
- Kirschner, P.A. & Valcke, M.A.M. (1993). From supply driven to demand driven education: New conceptions and the role of information technology therein. *New Technology in the Human Services*, 6, 4.
- Kirschner, P.A., Hummel, H., Vilsteren, P. van & Wigman, M. (1996). A study environment for acquiring competence, submitted for publication in *Studies of Higher Education*.
- Kirschner, P.A., Hermans, H., Valcke, M. & Koolhaas, J. (1996) *Business game learning environment: Business science in the 21st century*. Paper presented at the EDINEB Conference in Orlando Florida, December 6, 1996.

- Kirschner, P.A. & Valcke, M.A. *From supply driven to demand driven education: New conceptions and the role of information technology therein.* - HUSITA 3 conference, Juni 16-18, 1993 in Maastricht.
- Kolb, D. (1984). *Experiential learning: Experience as source of learning and development* Englewood Cliffs, NJ: Prentice-Hall.
- Kolb, D.A., Rubin, I.M., & Osland, J.S. (1991). *Organisational behaviour - An experiential approach.* New Jersey: Prentice Hall.
- Lederman, L.C. (1994). Give a small child a hammer and soon everything needs hammering. *Simulation & Gaming*, 25(2), 215-220.
- Tulving, E. (1983). *Elements of Episodic Memory.* New York: Oxford Univ. Press.
- Twiggs, C. (1994). National learning infrastructure, part 2. *Educom Review*.
- Valcke, M. & Vuist, G. (1995). A model-based design approach for the flexibilisation of courses. In F. Lockwood (ed.) *Open and distance learning today.* London: Routledge, 185-196.
- Valcke, M., Martens, R., Portier, S. & Weges, H. (1996). Tailoring distance education to the needs of learners in the workplace: Flexible learning materials as a key variable. In G. Potter (ed.) *Reflections on the future of work and learning.* Fredericton: University of New Brunswick, 183-190.

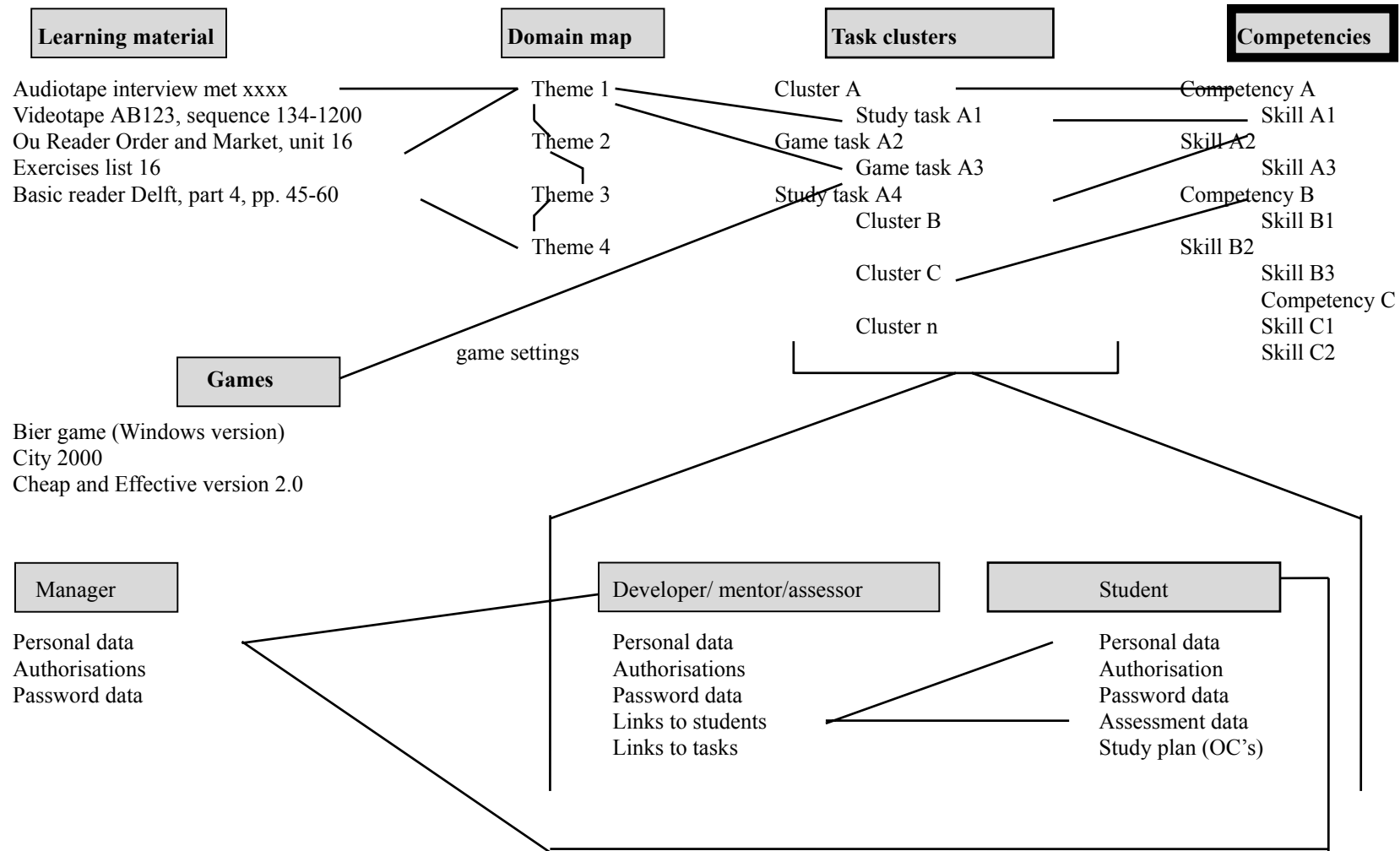


Figure 3 Structure of the B21 database

