

17 ICT-rich and Competency Based Learning in Higher Education

T. J. van Weert

Cetis, Expert Centre for ICT-based Innovations in Higher Education
Hogeschool van Utrecht, University for professional development and applied science
P.O. Box 85029, 3508 AA Utrecht, The Netherlands
t.vweert@cetis.hvu.nl

Abstract

In higher education the focus is changing towards development of professional competence of students: Students learn to apply knowledge in professional situations. Their results and competence development must be measured and assessed, just as in professional life. Characteristic of these professional situations is innovation with ICT as integral part. The associated educational concept is known as 'competence-based education'.

What is competence? And how can it be developed and ascertained? A control structure of reviews and assessments for competence based learning environments is proposed. Authenticity is pointed out as an issue.

Three examples of competence based education are presented which are analysed with respect to control and authenticity.

Keywords: Control structure, Review, Assessment

1. Introduction

In their future working and professional environment higher education graduates are expected to effectively work in the "Information Society". This work is knowledge intensive and ICT-rich. Implied is a change from application of disciplinary topics to competence based working where knowledge, skills and attitudes are integrated across the borders of separate disciplines (Hammer, 1993). Traditional knowledge is not sufficient in these dynamic working situations. Knowledge has to be enhanced with 'know how', 'know why' and 'care why' (Duffy, 2001). Emphasis is on meta-cognitive competences and "Tacit Knowledge" [van Weert, 2002].

Students in higher education need a learning environment in which they can learn to operate at the level required for starting a professional career. The learning environment therefore should take realistic account of the future working and professional environment with the main focus on development of professional competences of students. The students learn to apply knowledge in professional situations; their competence development is measured and assessed, just as in professional life. This is the characteristic of an educational concept which is often termed 'competence-based education' (Hezemans, 2002).

In our society Information and Communication Technology (ICT) is becoming an ubiquitous tool. This is even more true in the professional world. It is normal for higher education graduates to use generic ICT-tools like e-mail, browser, text processor, but also discipline specific tools like Mathematica, SPSS or a database on law. These tools therefore also should be integral part of the higher education learning environment.

2. Competence at work

2.1. What is competence?

In professional practice a switch is being made from job-based to competence-based working (Lawler III, 1994). The tasks of the professional have become more complex and involve both disciplinary and other competences (Hammer, 1993). The modern higher educated professional operates in multidisciplinary environments in various roles: for example in the role of facility manager, business consultant, informatics researcher. These roles are characterised by typical, professional problem situations which have to be dealt with. Professionals can be seen to have a particular competence in a particular role when they are able to solve the typical problems encountered in that role in a professional way. And professional problem solving implies use of a professional method, a professional way of working and a result conforming to professional standards. A typical example of this is medical practice.

2.2. How can competence be ascertained?

In cases where professionals deal with innovative problem situations, it is difficult to ascertain that the professional has a particular competence, because the problem solved is not standard. In such cases professionals can account themselves and thus show that they have a particular competence. This accounting can be done in two steps: review and assessment. In a review professionals check their competence against criteria. The following questions have to be answered:

- Why is this problem situation typical for my competence?
- Why did the work process conform to accepted professional standards?
- Why is the result conform to accepted result standards?

In the assessment the professional proves to an outside expert that there are reasoned answers to these three questions.

A typical example of this is the way of working in innovative software houses (Symes, 1997).

2.3. How is competence developed?

While working on new problem situations encountered in the professional role, new competence is developed. Modern knowledge intensive organisations work in this way. They tackle innovative problems and thereby further develop their competence. This allows them to stay competitive in a demand driven, continually changing market. An example of this is business consultancy where changing demand changed the focus from making existing business processes more efficient to business process redesign. Many knowledge intensive organisations therefore turn out to be also learning organisations. Learning is done at all levels: business level, team level and individual level.

From the constructivist perspective competence is developed by doing (Duffy, 1993). From this perspective a model for academic education was developed at Nijmegen University (van Weert, 1995 A). The model was developed using established theories on learning, taking account of empirical data. Central in this learning model is a problem solving cycle which is practically identical with the professional problem solving described in Subsections 2.1 and 2.2. This supports the assumption that in knowledge intensive, innovative professional environments working and learning have a symbiotic realtion.

3. Learning in a competence based learning organisation

Let us model competence based learning organisations after these knowledge intensive organisations which are also learning organisations.

3.1. Competence development at individual level

In competence based education students work in a professional setting where they have to solve problems, typical for the role they are learning to play. They have to adopt a professional approach to the problem and the result of the problem solving process has to meet professional criteria. They review their achievements against agreed criteria or standards. The result is twofold: they can show their competence at individual level and they learn how to do better still.

3.2. Competence development at team level

As in professional life students have to solve problems, in many cases multi-disciplinary in nature, in team work with

other students. This team work has to be effective, conforming to professional standards. Students need to show competence in individual work, but also competence at team level. Team (peer) reviews reveal competences at team and individual level, at the same time allowing team and individual learning to take place.

3.3. Competence at organisation level

Teams of students work in an organisational context. This context decides what roles there are to play, which problems are worthwhile to solve, what methods are suitable and which results acceptable. Students have to show that they are able to work effectively in this context: Both the individual and the team have to show competence at the organisation level. The necessary reviews will also facilitate learning of individuals, team and organisation.

4. Control: Reviewing and assessment

How are the processes of work in a knowledge intensive organisation or business controlled? Take for example software houses where innovative software is produced. One can observe that control is realised through the following means:

1. The work is structured in projects in which teams work following a project method structuring their work;
2. At particular moments in time (typically at the start, when milestones are delivered and at the end) reviews and assessments are planned.

The advantage of this approach is that the same control mechanisms can be used, independent of the particular software developed. The focus is on the process of control, not on what is controlled.

Reviews and assessments typically deal with:

1. The individual professional role: effective role performance, effective problem solving and quality results;
2. The team professional role: effective team performance, efficient project work and quality results, effective communication and co-operation;
3. The organisation professional role: effective organisation performance, synergetic and cost-effective programme of work

An innovative software house has to keep pace with developments and therefore also behaves as a learning organisation. As a consequence there are also reviews and assessments on learning, both of individual, team and organisation. These reviews and assessments deal with:

1. The individual professional development (learning in the professional role);

2. The team professional development (learning to perform better as team);
3. The organisation professional development (learning to perform better as organisation).

4.1. Reviews

Reviews are forward looking. Professionals learn how they do and how to do better from answering “Why”-questions:

- Why is this a “rewarding” problem, both for customer and organisation? Or do we need to adapt our goals?
- Why is the plan to tackle the problem a “good plan”: why will it work and why will it produce the desired results? Or do we have to adapt the plan?
- Why are the results produced by this process of the “right quality”? Or do we need to change the process or lower the quality?
- Why is the process of production and development efficient and effective. Or does it need interventions to do better?

Reviews are done against criteria or standards and lead to review interventions that aim to better the process and the results. From a knowledge point of view there is the interesting “by-product” of development of insight by the professionals. This insight allows for enhancement of competence, which is: learning.

4.2. Assessment

Quality of the review process is guaranteed through assessments in which review process and results are checked and judged by professional experts who are not part of the project. Assessments are not forward looking, but take account of the present situation. On the basis of their findings the experts will pronounce a “verdict” on the quality of the reviewing and review results and effects.

5. A quality control structure

On the basis of the above observations a quality control structure for competence based learning organisations can be constructed.

In the project setting in which higher educated professionals work, problems have to be solved following a professional method. Professional project methods identify milestones: Intake Check, Development Milestones and Final Result. Quality of process, results, role performance and personal development are monitored throughout the project in the following way.

5.1. Individual level

At intake: Professional Role Definition (PRD) and Personal Development Plan (PDP).

At Development Milestones and Final Result: Reviewing against the criteria formulated in the PRD and PDP.

5.2. Team level

Intake Check: Project Start-Up Review

Development Milestones and Final Result: Review of Process and Result; Professional Role and Development peer reviews

5.3. Organisation level

Intake Check: Team Contract Start-Up assessment

Half-way at Development Milestone: Team Contract Development assessment

Final Result: Team Contract assessment, Personal Role assessment, Personal Development assessment

6. Authenticity of learning situations

A student as innovative knowledge worker has two roles: working and learning. In both cases the student monitors process and results against criteria that were defined before the project started. Students take responsibility for working and learning (Hezemans, 2002) and review their achievements. In so doing they can better their performance.

For the working and learning of a student to be successful authenticity of the learning situation is an issue. When students perceive the learning situation as authentic, they are motivated to take responsibility. The learning situations therefore should be designed in such a way that the student can identify with the role of an innovative knowledge worker. This implies that a learning environment should allow students to have influence in both problem selection and the process of problem solving (working).

Of particular importance is the authenticity of reviews and assessments. For example, in real life assessment is done by experts in the professional domain who follow an agreed assessment protocol. A teacher, however, is in most cases not perceived as such an expert by the students. It pays to enhance authenticity by involving “real” experts from the professional domain in the assessment.

7. Competence based learning in practice

7.1. Example E-commerce

This example is one of three courses, developed as part of the project “ Task based team learning with ICT” of the Hogeschool van Utrecht (University for professional education and applied research) and the University of Utrecht (van Weert, 2002).

- It is a multi-disciplinary course in which participate:
- Third year students from five different part-time higher education studies in Economics (about 100 students);
- A support team of teachers (7 persons);
- An expert from professional practice, in this case the Service Line Manager, Business Consulting, Oracle Netherlands;
- Customers from the business world with a need to know how to apply E-commerce in their business.

The learning situation was modelled after professional practice and students used a professional method to solve the problem from real business life. ICT was used to support the interaction and communication between students, teachers and external professionals.

E-commerce is the whole of business actions (by businesses, organisations, consumers and public authorities) which are executed electronically, to enhance efficiency and efficacy of market and business processes. The processes concerned are both internal business processes and processes of interaction with third parties. Not only transactions (buying and selling) are part of E-commerce, but also processes preceding these transactions (such as marketing, market research) and following these transactions (such as billing, distribution, after sales).

A business plan in which all these processes are reviewed from the E-business point of view, is the basis on which management can decide that E-commerce is efficient, effective and feasible for the business or the organisation. The task for the students is to develop such a business plan.

Criteria were given for the business plan, the innovation definition (analysis and choice of E-commerce strategy) in the business plan, the method used and the work process. These criteria were developed in co-operation with the Service Line Manager, Business Consulting, Oracle Netherlands.

Students were asked to prepare a Personal Development Plan covering: Professional and business creativity, Co-operation skills, Sensitivity for developments in the market and the business environment, Problem analysis competence and decision making, Oral and written communication. The Personal Development Plan was used to assess student performance during the project work through peer assessment, expert assessment and project coach assessment.

The final assessment has two components:

1. The business plan, developed by the team of students, is assessed against the result criteria.
2. The development of student competences is assessed against overall criteria and the criteria in the Personal Development Plan.

Discussion The learning environment in this example is fairly authentic, but influence of students on the process is limited. Reviewing as a means to let students themselves control quality, is underdeveloped. There is a form of intake assessment, but only with respect to the project plan. There is a limited form of half-way assessment of process and intermediate results. An external expert is involved in the final assessment, but only with respect to the final result.

7.2. Example Virtual Environmental Consultancy Agency

The "Virtual Environmental Consultancy Agency" (VECA), described in (Ivens, 2002) was first started in 2000 by the Open University of the Netherlands in co-operation with Maastricht University. It was further developed in 2001 and is currently operating in the context of the Dutch Digital University. It is based on earlier experiences within the Open University of the Netherlands with the concept of a 'virtual company' (Westera, 1998), (Westera, 2000).

The VECA is mediated via a computer network. It combines the flexibility of distance learning with integration of learning and working.

Within the VECA, all processes are dominated by the concept of *competence learning*: learn how to complete tasks by integrating complexes of knowledge, skills and attitudes. Therefore before start-up an exhaustive inventory has to be made of the competencies required. The resulting *competence map* is pivotal because it acts as a frame of reference for all processes involved: it limits the range of products and services rendered, and defines what can be learned by the students.

In running a VECA one can distinguish three main phases: the preparatory phase, the actual working period en the final assessment.

Preparation During the preparation phase potential orders are acquired from external clients. These orders are mapped into a competence map, first of all to decide whether they will be accepted or not.

Furthermore, students have to be recruited. Competence counsellors, who are members of the educational staff, diagnose new students against the competence map. Identified gaps in competence constitute the student's career plan. The career plan is subsequently used as the starting point for assigning sensible tasks to the students.

The work period The work starts with a plenary face-to-face introductory meeting. Thereafter project teams start carrying out their work. An extensive system is established that monitors and assesses students' (in)competencies. It includes traditional teacher controlled evaluation (co-assessment) procedures as well as methods for self- and peer-assessment by the students themselves. The latter are used to assess the individual's informal knowledge and functioning. The working period is concluded with a final face-to-face meeting where results are presented to the external clients and all members (students and teachers) of the VECA.

Final assessment All documents produced in the course of a student's career, for example results of assessments and results produced for customers, are collected in a personal portfolio which forms the basis of establishing and formalising performance levels. By asking the customers to assess the merit of the final result an external assessment of the student's work is made. This too is incorporated in the portfolio. Collectively these assessments also contain a reflection on the effectiveness and quality of the entire learning environment, including the teaching. Based on the portfolio the examiner establishes a final mark for each individual student (Figure 1).

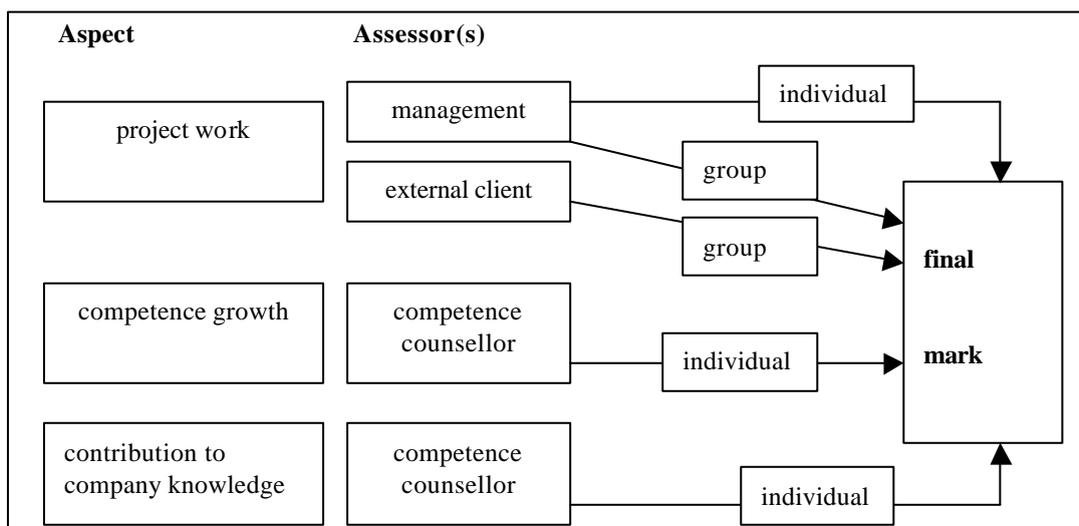


Figure 1: Schematic presentation of the final assessment (Ivens, 2002).

Discussion The learning environment in this example is fairly authentic. Student influence on the process is limited. Reviewing as a means to let students control quality, is integrated in the process. There is intake assessment, but only with respect to student competencies and their relation to the Competence Map; students are not involved in the project selection. The students themselves create a Personal Development Plan, but the teaching staff decides on the project, the role of the student and competencies to be developed. Authenticity here could be better. There is on-going reviewing and assessment of process and intermediate results. An external expert is involved in the final assessment, mainly to assess the final result and its presentation, but also to assess customer management.

7.3. Example Student Software House 'GiPHouse'

The professional student software house GiPHouse is described in (van Weert, 1995 B). The software house produces not too complex software systems for real-life customers. Students in GiPHouse learn to "help themselves". They start their projects with a general problem description of half a page, the address of the customer, a GiPHouse manual explaining the basics of the organisation (Symes, 1997) and a

GiPHouse standard development method. After that it is up to the students to find suitable techniques to tackle their project, to organise, plan, manage their teams etc. However, students who have been involved in earlier phases of GiPHouse, bring their knowledge over on younger students, thus providing a learning network. These more experienced students perform senior roles such as Senior Developer, Project Manager, Quality Manager, Human Resource Manager or Contract Manager. Focus point of the management is the GiPHouse Director, an external professional with extensive experience in development of large software systems and quality control.

GiPHouse has been modelled after modern, innovative software houses. The working methods are geared towards effective project work and the business culture is one of participation and shared responsibility. Reviewing and assessment is integrated in the work process (Figure 2.).

Discussion The learning environment in this example is very authentic. Students have important influence on the process, because all roles in the software house are performed by students, except the director role performed by a professional. In their role the students have responsibilities, but also the decision power associated with these responsibilities. More experienced students are involved in all assessments in a

professional role. Reviewing is used extensively as part of the GiPHouse working method (Figure 2). Intake reviews (Intake Check, Project Start-Up) and Intake Assessment (Contract Start-Up Review) are well developed. There are on-going reviews (Progress Review, Quality Review) and a half-way assessment of Progress, Quality and Role Performance (Development Review). In the final assessment (Contract Evaluation Review) customer satisfaction is also input.

The review and assessment structure is basically identical with the quality control structure outlined in this paper.

8. Conclusion

A quality control structure is needed in competence based higher education learning environments. In this paper a control structure based on reviews and assessments is proposed. This structure is derived from authentic professional environments. Three examples from educational practice were given in which (part of) this control structure is used, illustrating the feasibility of the approach.

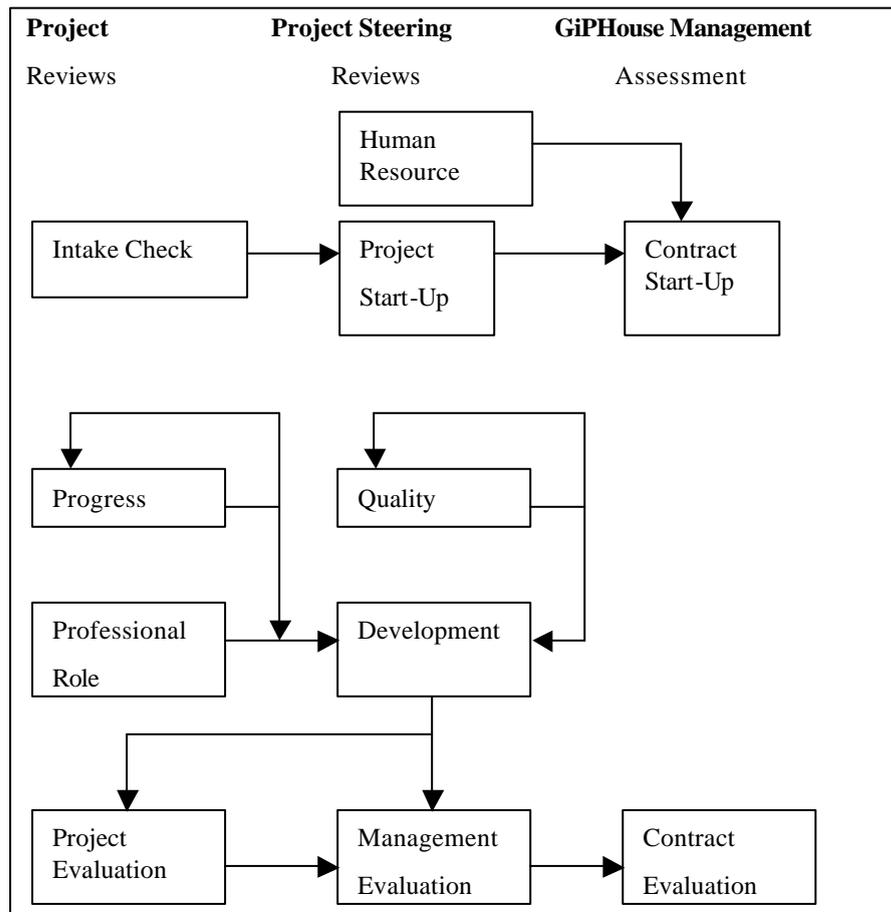


Figure 2: Review and assessment structure of GiPHouse (Symes, 1997).

References

- Duffy, T.M., J. Lowyck & T. M. Welsh (1993) *Designing environments for constructive learning*. Berlin: Springer Verlag.
- Duffy, T. M. & C. Orrill (2001) *Constructivism*. In: A. Kovalchic & K. Dawson (Eds.) *Educational Technology, An Encyclopedia*. Santa Barbara, CA: ABC-CLIO.
- Hammer, M. & J. Champy (1993) *Re-engineering the corporation*. London: Nicolas Brealy Publishing.
- Hezemans, M. & M. Ritzen (2002) *Learning environments and responsibility*. In: Proceedings of the Tele-learning Stream of IFIP Congress 2002. Norwell, MA: Kluwer Academic Publishers.
- Ivens, W.P.M.F. (2002) *New ways of academic education: chances for sustainability*. In: Michelsen, G., M.C.E. van Dam-Mieras (Eds.) *The Lueneburg Declaration, Stepping*

stone for universities and development in the context of globalisation (in print).

Lawler III, Edward E. (1994) From job-based to competency-based organizations, *Journal of Organizational Behaviour*, Vol. 15, p.p. 3-15.

Symes, J. & T. J. van Weert (1997) *GiPHouse Handbook*. Nijmegen: Universitaire School voor Informatica, Katholieke Universiteit Nijmegen.

Weert, T. J. van & P. Jongepier (1995 A) *Een model voor academisch informatica-onderwijs*. Nijmegen: Universitaire School voor Informatica, Katholieke Universiteit Nijmegen.

Weert, T. J. van (1995 B) *GiPHouse, a professional student software house*. In: Tinsley, J. David and van Weert, Tom J., Eds. (1995) *IFIP World Conference on Computers in Education VI, WCCE'95 Liberating the learner*. London: Chapman & Hall, p.p. 429-439.

Weert, T. J. van & A. Pilot (2002) Success factors in the design and development of new learning. Submitted to: *Education and Information Technologies*.

Westera, W. & P.B. Sloep (1998) The Virtual Company: towards a self-directed, competence-based learning environment. *Educational Technology*, Vol. 38 (1), pp. 32-38.

Westera, W., P.B. Sloep & J.F. Gerissen (2000) The design of the Virtual Company: synergism of learning and working in a networked environment. *Innovations in Education and Training International* 37 (1), pp. 24-33.