# Competency-based education in an electronic-supported environment: an example from a distance teaching university

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**Abstract:** Competency-based instruction can be applied to various settings, including an academic programme with a focus on producing performance-based learning outcomes. This paper provides theoretical and practical information about underlying characteristics of competencies and introduces a Master's programme, which has recently been started at a distance teaching university. It is aimed at fostering competencies needed in a knowledge-based society and prepares learners to respond to increasing demands of the working life. Its focus is on technology-enhanced settings such as e-learning, e-teaching or blended learning. A detailed description of the introductory module will be given to illustrate how theoretical and didactical approaches can be combined in a practical way.

**Keywords:** distance education; educational technology; authentic learning environments.

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## 1 Introduction

For several years, it has been argued by many authors (Bastiaens and Martens, 2000) that rapid technological and societal changes result in a need for complex knowledge at work. A 'new' view on learning has emerged, based on constructivist design theories (van Merriënboer et al., 2002) in which real-world problems are presented dealing with complex skills (Simons et al., 2000). Modern instructional design models assume that realistic and rich learning tasks are the driving force for learning (Merill, 2002). Well-designed learning tasks stimulate learners to integrate and coordinate required skills, knowledge and attitudes. This finally leads to a rich knowledge base that allows for transfer to daily life and future work settings (van Merriënboer et al., 2004).

Due to the rapid developments of innovative ICT, electronic-supported learning environments provide various opportunities to build on these models which can then ensure high quality for teaching and learning. A necessary step in this regard is to prepare practical guidelines so that learners can utilise theoretically founded principles in their professional contexts. In this paper, we attempt to move towards this direction and present a show case, a recently launched Master's programme at a distance teaching university. Before we do that, we would like to discuss some underlying aspects. We will start with a literature review regarding the didactical approach. Important aspects of competency-based learning will be identified and it will be shown how they can be utilised for higher education. For this purpose, we will introduce the Master's programme eEducation which has a special focus on technology-enhanced learning. The overall structure of this programme is in close adjustment to our didactical and theoretical approach and is aimed at equipping students with competencies needed for the ever-changing knowledge-based society.

## 2 Literature review: competency-based learning

During the past decades, the term competency has emerged as a major concept in educational science, in particular in relation to the development of human resources. However, intensive and substantial debates have just begun and they are being accompanied by attempts to characterise changed demands in the real world as well as in business and industry. In this paper, we will adhere to the definition suggested by Klieme and Leutner (2006) which states that competencies are context-based cognitive dispositions that are functionally related to situations and demands in specific domains. Furthermore, it is argued that competencies cannot be observed directly (latent variable) which leads to the conclusion that assessment methods have to take this into consideration. A promising approach in this regard pertains to electronic-portfolios (e-portfolios) (Barrett, 2003). They can compile exactly those kinds of information which are needed to make meaningful judgements about the attainment of competencies. E-learning environments also support Competency-Based Education (CBE) that allow students some degree of choice regarding learning content and method of instruction as well as providing worldwide access to library and learning.

Competence-based training is seen as the way in which to respond appropriately to the claims and demands of business and industry, among others, and to prepare learners for the role they will play in future working life and in society. Support for competence-based training is growing. Since the mid-nineties there has been a plethora of articles on

competences. Almost every author adopts his or her own definition or subtle distinction (Stoof et al., 2002). Unfortunately for the practical side, to date there is no clear definition of the term (Schlusmans et al., 1999). Nevertheless, there has been agreement that CBE aims to develop these kinds of competencies as professional needs in a systematic way.

The underlying theoretical assumption states that learners become responsible for regulating their own learning process (Pintrich and Schunk, 2002). So-called self-regulated learners are motivated, independent and metacognitively active participants of their own learning (Bastiaens and Martens, 2000). There are instructional methods or models that are built upon self-regulated learning and hold that it is crucial to generate learner's motivation. For this reason, many of the (computer-based) learning environments constructed present realistic problems, for instance through a simulation or a game (Garris et al., 2002).

Research by Stoof et al. (2002) shows that the confusion over the term competence does not only make theorising more complicated but also poses problems in practical educational and training innovations. Too much time is spent on differences of opinion on its details, and it is often found during implementation that an injudicious use of the term as an underpinning to innovation leads to results which in essence differ little from more traditional approaches. It would be more rewarding to understand competence-based training as an approach allowing us to look critically at these more traditional forms of training. Such a comparison with the old situation is therefore often a better basis. The table of differences between traditional education and training and competence-based training (Jochems and Schlusmans, 1999) below provides a firm foundation on which to proceed.

**Table 1** Traditional versus competence-based training (based on Jochems and Schlusmans, 1999, p.50)

| *Traditional training* | *Competence-based training* |
|---|---|
| The curriculum is based on knowledge contents and discipline-oriented skills | The curriculum is based on competences displayed in accomplishing tasks and dealing with practical or problem situations |
| Learners study pre-determined contents | Learners carry out learning tasks, either with or without other learners |
| All learners go through more or less the same curriculum | A made-to-measure curriculum is put together depending on the entry level |
| Knowledge and skills are tested | Mainly testing of competences |
| Trainer or teacher-controlled testing | Also self-assessment and peer-assessment |
| Separate skills modules | General skills are integrated into learning tasks |
| Training units are derived from separate disciplines | Training units to a significant degree are interdisciplinary |

van Merriënboer (2001) postulates three aspects of competency-based learning that will play a major role in the near future. Those are:

- the design of learning tasks is at the heart of competency-based learning or a competency-based curriculum;
- learning tasks will be performed more and more in technology-enhanced environments and
- testing and assessment of competencies will become important, asking for new approaches to diagnosing learner progress.

In competence-based training, learners are no longer primarily trained to pass their examinations but to learn independently and to manage their own learning process. Training on the basis of authentic tasks is an essential feature of this. When learners are confronted with real and meaningful learning tasks, the learning becomes more meaningful and interesting for them. The most significant feature of an authentic learning task is that this must deliver a learning experience closely related to reality. Oliver and Herrington (2000) have formulated a number of conditions to be met by authentic learning tasks. For instance:

- they must provide an authentic context, which reflects the skills necessary in reality;
- the learning tasks must encourage authentic activities characterised by relevance to reality and
- authentic learning tasks must make possible access to expert performance.

Technological applications can support working on authentic learning tasks. Using ICT, 'real' environments can be created in which learners work on attaining their competence and carry out tasks as 'real employees', explore new fields, meet various people and use varied methods and instruments for the gathering of information and solving of problems (Gullikers et al., 2002).

### *2.1 Assessing competency*

How can one assess competency adequately? A simple employment of traditional measurements is not suitable. Therefore, criteria that clearly reflect the concept of competencies are needed. This was the goal of the 'wheel of competency assessment' developed by Baartman et al. (2006). It entails a framework of quality criteria and is a synthesis of work by many different authors. The framework provides a clear definition of all criteria and avoids container concepts to enable a further operationalisation of the criteria into an instrument. Criteria were described separately as much as possible.

Since we argue for a programme of competency assessment, part of this CAP might be a very authentic performance assessment, while another part might be a test to determine underlying knowledge. The assessment programme as a whole is evaluated against the criteria, of which some methods may score high on some criteria and other methods on different criteria. The following quality criteria are important:

- *Authenticity* relates to the degree of resemblance of a CAP to the future professional life. A CAP should assess those competencies needed in the future workplace (Gulikers et al., 2004).
- *Cognitive complexity* resembles authenticity in the sense that it also relates to the processes applied in future professional life, but it focuses more directly on the fact that assessment tasks should also reflect the presence of higher cognitive skills (Hambleton, 1996). An assessment task, depending on the phase of education, should elicit the thinking processes used by experts to solve complex problems in their occupational field. In this respect, Hambleton (1996) remarks that the use of performance assessments is no guarantee that higher cognitive skills are indeed being measured.

- *Meaningfulness* implies the fact that a CAP should have a significant value for both teachers and learners (Hambleton, 1996), to which the importance in the eyes of future employers could be added. A possible way to increase meaningfulness is to involve learners in the (development of the) assessment process.
- *Fairness* specifies that a CAP should not show bias to certain groups of learners and reflect the knowledge, skills and attitudes of the competency at stake, excluding irrelevant variance (Hambleton, 1996). Possible causes of bias are improper adjustment to the educational level of the learners or tasks containing cultural aspects that not all learners are familiar with.
- *Transparency* relates to whether a CAP is clear and understandable to all participants. Learners should know the scoring criteria, who the assessors are and what the purpose of the assessment is. As a possible indication of the transparency of an assessment, Hambleton (1996) suggests to check whether learners can judge themselves and other learners as accurately as trained assessors.
- *Educational consequence* is mentioned as a criterion for competency assessment by many authors (e.g. Dierick and Dochy, 2001) and pertains to the effects a CAP has on learning and instruction. A collection of evidence is needed about the intended and unintended, positive and negative effects of the assessment on how teachers and learners view the goals of education and adjust their learning activities accordingly (Linn et al., 1991). This criterion is also related to effects like washback (Alderson and Wall, 1993).
- *Directness* considers the degree to which teachers or assessors can immediately interpret the assessment results, without translating them from theory into practice (Dierick and Dochy, 2001). A theoretical test does not immediately show if a learner is competent in a job situation, whereas a performance assessment does.
- *Reproducibility* of decisions relates to whether the decisions made on the basis of the results of a CAP are accurate and constant over time and assessors. This does not mean that a CAP must be objective (van der Vleuten and Schuwirth, 2005). Using performance assessments, assessors subjectively judge the performance of learners. Important is that the decisions about the learner are made accurately and do not depend on the assessor or the specific assessment situation.
- *Comparability* addresses the fact that a CAP should be conducted in a consistent and responsible way. The conditions under which the assessment is carried out should be, as much as possible, the same for all learners and scoring should occur in a consistent way, using the same criteria for all learners. Possibilities to increase comparability include careful sampling across conditions and using a large sample across the content and situations of the competency at stake (van der Vleuten and Schuwirth, 2005).

All these criteria are influential for the still to be discussed Master's programme 'Education and Media: eEducation'.

## 3 Instructional design model 4C/ID

Simply providing learners with information is not enough (Deimann and Bastiaens, 2008); it does not necessarily mean that people learn from the occasion. Informing people does not involve instruction, although, for sure, people can learn informally and learning does not always mean intentional learning. This is an opportunity for the (traditional) field of Instructional Design (ID).

The Four-Components Instructional Design Model (4C/ID) developed by van Merriënboer et al. (2002) offers designers' guidelines. It supports the development of complex tasks for learning that are often used in higher education. The Master's programme represents a potential case to utilise the principles of the 4C/ID which will now be explained in more detail.

The model distinguishes between non-recurrent aspects of learning and performance, which involve problem solving or reasoning and differ from situation to situation, and recurrent aspects which are identical from one situation to another (e.g. application of procedures or routines). The model in general exists of four interrelated blueprint components. The backbone of the model is formed by *learning tasks* which are defined as concrete, authentic and meaningful 'whole task experiences'. They are sequenced in simple-to-complex task classes. Ideally, they confront learners with all aspects of a professional competency.

The second component is called *supportive information*. This is information that is supportive to the learning and performance of non-recurrent aspects of learning tasks (e.g. problem solving and reasoning) within the same task class. It helps to develop mental models and cognitive strategies.

*Just-in-time information* is the third component and is a prerequisite to the learning and performance of recurrent aspects of learning tasks. It is relevant to the performance of routine aspects of the learning tasks. In general, these are small information units and presented to learners – just-in-time – while working on the learning tasks. The MS-Office applications utilise just-in-time information in the form of intelligent wizards that provide support when they sense problems.

The last component is called *part-task practice*. These are in fact additional exercises for recurrent aspects of learning tasks for which a very high level of automation is required after instruction.

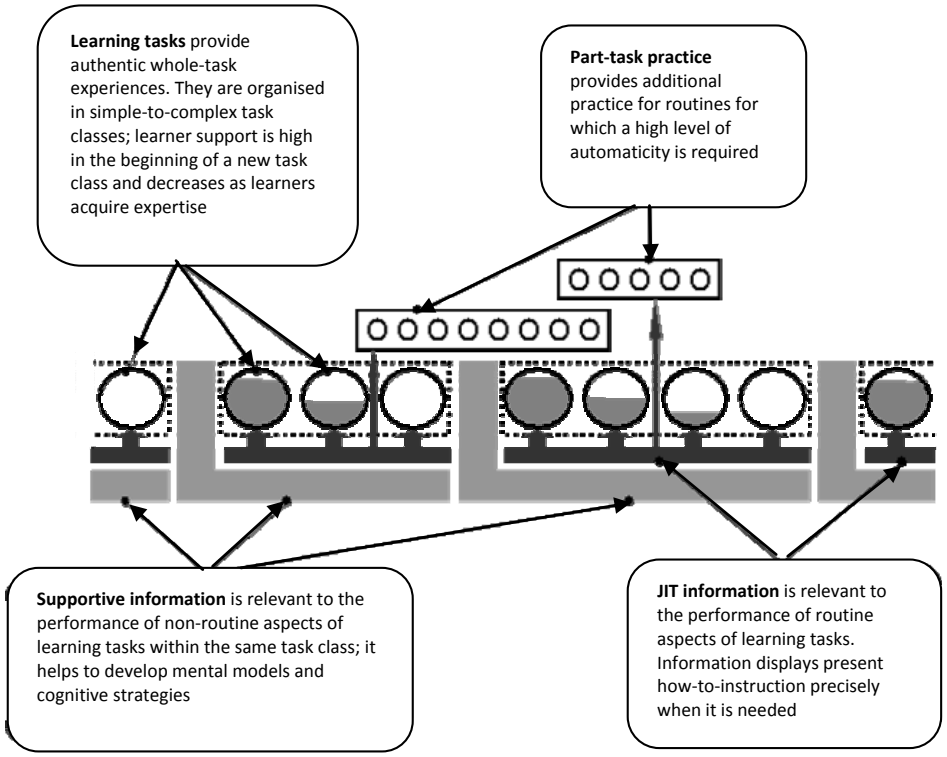
Figure 1 provides a schematic overview of the four components. The sequence of learning tasks, represented as circles, serves as a backbone. Equivalent learning tasks belong to the same task class (the dotted rectangles around the set of learning tasks in Figure 1). The equivalency means that they can be performed on the basis of the same body of knowledge. Each new task class is more difficult than the previous task class. Learners receive a great deal of guidance and support for their work on the first learning tasks in a task class. This guidance and support decreases in a process of 'scaffolding' as learners acquire more expertise. In Figure 1 this is indicated by the filled circles. The last learning task in a task class is empty, meaning that the learners work without any support on this final learning task. Often this last task is also used as a test task for the assessment of learner's performance.

The main goal of 4C/ID is to support and enable educational developers to construct learning materials for complex tasks that are in line with cognitive load theory (Kirschner, 2002), implying that the complexity of these materials do not overwhelm the students. In particular, learning in technology-enhanced environments oftentimes do not

account for important constraints of the learner. Past research has shown that the capacity of the working memory is limited (Baddeley, 1986). Based on this, guidelines for designing learning materials have been developed (Mayer, 2002) which are highly relevant for innovative ICT. Neglecting these principles can lead to motivational problems during the learning process, e.g. lost in hyperspace (Deimann and Keller, 2006).

Both competency-based learning and complex learning environments (based on 4C/ID) provide valuable information concerning e-competence for academic stuff. In the remaining part of this paper we present a case which attempts to utilise these benefits.

**Figure 1** Schematic overview of the four components: (a) learning tasks, organised in task classes and with scaffolding within each task class, (b) supportive information, (c) JIT information and (d) part-task practice




## 4 Realisation: the Master eEducation

The consecutive Master's programme 'Education and Media: eEducation', which has started in October 2008, is aimed at qualifying learners to analyse, plan, design and evaluate electronic-supported learning environments in a scientific and academic way. Furthermore, students should be able to transfer acquired competencies to professional contexts. Being relatively unknown, eEducation comprises both sides of education, i.e. teaching and learning. Consequently, eEducation entails all forms of electronic-supported teaching and learning: satellite-supported learning, interactive TV, DVD, WBT, mobile

learning, etc. The design is based upon a blended-learning approach that not only comprehends formal arrangements but also so-called accidental learning. This form is not structured in terms of learning objectives, learning time and/or learning support and may happen at an unexpected moment about an unexpected subject. In other words: "It is the knowledge we had not set out to acquire but we chance upon in conversation, listening to the radio or web surfing, for example, equivalent to the serendipitous kind of learning that results from reading an entry that catches our eye whilst turning the pages of a dictionary or encyclopaedia" (Comas-Quinn et al., 2009, p.101).

The theoretical conception builds on the aforementioned ID-Model 4C/ID and on the concept of competency-based learning. Contents of teaching are being developed based on current research activities at the Institute of Educational Science and Media Research (evidence-based practice approach). Research is closely linked to teaching practice which is conceptualised as CBE. CBE is an institutional process that moves education from focusing on what academics believe graduates need to know (teacher-focused) to what students need to know and be able to do in varying and complex situations (student and/or workplace focused). In contrast to the concept of qualification, competencies are displayed as a creative performance and can be assessed, for instance, using an e-portfolio.

E-portfolios, as a relatively new form of assessing and evaluation performance, are utilised within the Master's programme against the background of the following principles (Barrett, 2001):

- E-portfolios focus on professional competency (instead of recallable knowledge)
- Competence or proficiency is displayed and evaluated in an e-portfolio
- There are no binary decisions (true/false); instead e-portfolios concentrate on the degree of goal attainment (problem solving)
- The grade contains a description of the achievement of objectives.

The overall goal of the Master's programme focuses on acquiring competency in research and practice within the educational field. Moreover, students are expected to work in multi-disciplinary groups, thus integrating knowledge from other disciplines (e.g. sociology or literature study). Our vision of competency-based learning with authentic learning tasks is worked out in four semesters, meaning a regular study time of two years which is structured in seven modules.

## 5 Modular approach

Students work through a total amount of seven modules before they work on a final scientific paper. Every module provides opportunities to gain specific competences. Table 2 gives an overview of the different modules and competences.

Each module is subdivided to focus on specific topics or issues, for instance instructional design in module 1 or legal conditions in module 5. The module reflects the overall structure of the Master's programme as a mixture of educational science and computer science (interdisciplinary approach).

There will be an e-portfolio available for the students throughout the entire Master to document, reflect and evaluate progress.

### 5.1 Example module 1: learning and teaching in the knowledge-based society

To illustrate the didactical approach of the Master's programme, module 1 will now be described. It is the starting module of the programme and for that reason a general introduction to the topic of knowledge-based society and the role of educational technology has been chosen.

**Table 2** Overview modular structure

| | *Overview module titles* | *Competence* |
|---|---|---|
| 1 | Learning and teaching in the knowledge-based society | Learners understand modern knowledge-based society, can explain it from an educational point of view and can take proper actions and deal professionally with it. |
| 2 | Educational requirements for utilising innovative form of learning and teaching | Learners are able to develop media and communication theories for educational purposes. They are also able to plan concepts of knowledge communication for their own educational projects and to analyse theoretical conditions. |
| 3 | Design and development of new media | Learners are able to select and use educational technologies based on theoretical questions from educational science and technology. |
| 4 | Applied educational research | Learners are able to critically reflect empirical research methods. |
| 5 | Fields of application and requirements for acting | Learners are able to develop economical and legal conditions, to judge foundations and current developments of cooperate communications and to handle projects within cooperate e-learning. |
| 6 | General social conditions | Learners are able to reflect societal implications of the usage of innovative educational technology |
| 7 | Compulsory optional subject | |

Learners will get acquainted to some heated debates such as the concept of 'Net Generation' (Oblinger and Oblinger, 2005; Jones et al., 2010). They will also get to know principles of learning and how they relate to learning with ICT. The materials consist of printed work books (course books) and a learning management system (Moodle). Teaching is not solely virtual, there are workshops (optional) and online seminars. The latter is realised using Virtual Classroom software (Adobe Connect).

We then pick up weblogs as a major trend in educational technology. Students first have to compare different blogs (e.g. http://halfanhour.blogspot.com). At this point they normally do not have an in-depth amount of knowledge. This is, however, part of the didactical approach, i.e. students should be carefully introduced to weblogs. After the evaluation, learners have to work on a concept for their own weblog. They can freely decide the topic; however, it should be clearly linked to educational theories. The concepts will be individually reviewed and if necessary modified. In keeping with the practical orientation of the Master's programme, we provide our learners with a weblog software to realise the concepts. They work for several weeks on their blogs and are encouraged to share their opinions, i.e. to post comments in other blogs. The design of the blogs should reflect their understanding of issues of multimedia learning (e.g. Mayer, 2001). Preparing postings that should reach fellow student is another important training in the first module.

The assessment strictly follows our competency-based approach. We utilised e-portfolios in such a way that during the semester learners upload various documents (draft, reports, etc.). By doing so, students' progress is visible and can be taken into account. There is a summative evaluation at the end of each semester. Results will be used to improve student's satisfaction with the course.

The aforementioned didactical approach is being implemented as follows. Authentic learning tasks will be used similar to tasks students will encounter in work life. In addition to that, authentic learning tasks can enhance transfer of complex problems (Bastiaens and Martens, 2000). In module 1, we introduce the concept of weblogs and stress its importance for educational settings. It is shown how weblogs as a major element of so-called Web 2.0 application influence learning and teaching today.

According to the scaffolding principle (van Merriënboer et al., 2002), learners get the most support at the beginning of the course. It has become clear that usually DE students are not yet quite familiar with innovative ICT such as weblogs. Therefore, we adhere to the 'simple-to-complex task classes' principle which is a key instrument to minimise negative effects of cognitive load (Sweller, 1988).

The first task includes an invitation for students to review and evaluate a list of selected weblogs. It is highlighted that learners do not need to have a substantial body of knowledge to pursue this task. Instead, learners should analyse weblogs based on their current expertise.

In the next more complex step, learners have to write a concept for their own weblog. For this task, learners receive supportive information (e.g. an online forum to discuss problems and issues with peers) and just-in-time information such as hints to relevant weblogs or podcast that may be helpful during a particular period. Since we can sense problems that learners encounter during certain work phases, such as finding a relevant theme for the weblog, we can match supportive information directly to them. After drafting the concept, learners have to implement their ideas, i.e. they should launch their own weblog. In an attempt to respond to learners' minor experiences with web-based developments, we are using a pre-installed software (WordPress MU). Each student will get a weblog to work with individually.

Part-task practice is also realised: students have to work on their weblog for several weeks. They write contributions and post comments in blogs of their peers. During this time, routine tasks occur which can enhance automatisation.

## 6 Concluding thoughts

The present paper has demonstrated, from a practical viewpoint, how theoretical and didactical models concerning competency-based learning can be combined and utilised for higher education. In particular, it has been shown that a solid didactical approach can enable learners to utilise their knowledge more efficiently. An illustrative case, Master's programme at a distance teaching university, was introduced and its basic structure was described. The overall purpose of this programme is to prepare learners so that they are able to master challenges in a knowledge-based society. Due to the increasing importance of innovative ICT (Web 2.0), a substantial part deals with web-based applications such as weblogs or e-portfolios. In this regard, the general principle (easy-to-complex) was deployed to avoid negative effects such as cognitive overload.

The Master's programme will be constantly refined to closely match changed conditions in research and practice. Moreover, it is hoped that the programme will generate sustainable effects for our knowledge-based society.

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