24. Models and Principles for Designing Competence-Based Curricula, Teaching, Learning and Assessment

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Introduction

This Volume shows that competence-based education (CBE) is a global educational innovation which has gained popularity because it is expected to stimulate learning that prepares students for the world of work and the society (Velde 1999; Mansfield and Mitchel 1996). CBE is a popular innovation in the vocational education and training (VET) system in many countries because the expectations are that it makes education more authentic and attractive for students. And because of this, fewer students are assumed to drop out of education before attaining their diploma and graduates are expected to experience less transition problems when starting to work in the labour market (Biemans, Nieuwenhuis, Poell, Mulder and Wesselink 2004). CBE is applied in educational practice on a large scale in many different countries (Mulder, Weigel and Collins 2007), but not always accompanied with convincing evidence of its added value.

Although the expectations regarding the added value of competence-based education are formulated clearly (i.e., motivated students and a smooth transition to the labour market) it remains unclear to what extent these expectations are met. In the Netherlands for example, Van den Berg and De Bruijn concluded already in 2009 that there were hardly any results on the effects of CBE in relation to the labour market (only some preliminary findings). In the period before 2009, there were hardly any students who completed an entire competence-based programme. Since then, no studies were conducted on the effects of CBE in the Netherlands (Van den Berg and De Bruijn 2009). Van der Meijden, Van den Berg and Román (2013) provided a study in which they compared the situation of Dutch VET institutions that joined experiments in which they started to use the (national) competence-based qualifications structure with VET institutions that did not yet implement the new qualifications structure. They studied the differences on the following areas: transfer to the labour market, motivation of students and commitment of the companies involved. They also studied factors like the role

of the teachers and the number of drop-outs, but in this chapter the first three result areas (transfer, motivation and commitment) will be discussed only. Van der Meijden et al. (2013) conducted interviews with key respondents from both companies and educational institutes, and concluded that it was too early to say something about the effects of using a competence-based qualifications structure on the transfer of students to the labour market. However, it was expected that students who were educated based on a competence-based qualifications structure acquired more so-called 'soft' skills, which would smoothen their entrance to the labour market. One of the observations of Van den Berg and De Bruijn (2009) was that educational practitioners have the impression that students after their graduation in CBE are able to more quickly find a job and that they experience fewer transition problems. This conclusion is not based on hard empirical data, however, but is based on the experiences of educational practitioners involved in CBE programmes. Based on the same research of Van der Meijden et al. (2013), it can be concluded that the motivation of students participating in educational programmes that adopted the national competence-based qualifications framework does not differ from students participating in more traditional programmes that did not yet adopt the national competence-based qualifications framework. The only conclusion that can be drawn is that there is a positive relationship between the extent to which the educational programme can be characterized as CBE and the motivation of students. So, the more the educational programme is based on competencies (that means in many cases that the programme has been working with a competence-based qualifications profile for a longer period of time), the higher the motivation of students. Van der Meijden et al. (2013) finally reported that companies that are involved in a competence-based programme show more commitment to the educational programme than those that are involved in more traditional programmes. Furthermore, these companies are also more satisfied about the extent to which they are involved. Thus, this research of Van der Meijden et al. (2013) shows positive outcomes of the implementation of CBE programs, but, as said, these conclusions are not built upon large-scale empirical data. It is still unclear to what extent study programmes that adopted the national competence-based qualification framework actually changed their teaching, learning and assessment remains.

In Australia the implementation of so-called CBE training packages was evaluated on a national level. Training packages were the carrier for the implementation of CBE and were nationally recognized qualifications based on competency standards and developed with considerable input from the industry. Because of the implementation of CBE, Smith, Comyn, Brennan Kemmis and Smith (2009) highlighted some major changes during the last twenty years. Several researchers evaluated the implementation of these training packages in Australia. Cornford (2000) for example concluded that it was still not known whether or not students start with less problems regarding the transition into the labour market than before; the evaluations did not show results that pointed in that direction. He concluded that teaching professionals (with whom he evaluated the implementation of CBE) did not indicate that students' skill levels had greatly improved with the introduction of CBE. And when it comes to student motivation, a vast majority of teachers in VET had severe doubts whether students' motivation was enhanced as a result of CBE. He nuanced this conclusion somewhat by emphasising that CBE seemed to be suitable for some specific occupational areas. Based on

the opinion of teachers involved in the particular areas, he considered CBE as beneficial for their specific areas (i.e. communications, jewellery), however, again, this was not empirically verified. The same evaluation in Australia yielded some curriculum changes: 1. the nature of curriculum went from descriptive and prescriptive to permissive, 2. the location of delivery was originally only in the classroom, and increasingly it was in both the classroom and the workplace, and 3. the role of the teacher evolved from being a gatekeeper to being a negotiator in the learning process. In Australia, as in the Netherlands, the evaluation activity did not incorporate the changes in teaching, learning and assessment as independent variables. The mentioned changes in the nature of curricula were even positioned as outcomes in the evaluation research.

Both examples show that there is a lack of evidence regarding the realisation of the intended outcomes of CBE. At least, the available results are not yet very convincing. According to Van den Berg and De Bruijn (2009), designing and implementing CBE at an educational programme level, when one takes it seriously, takes much time and involves an inclusion of a variety of dependent (i.e. student motivation) and independent variables (i.e. assessment). Van den Berg and De Bruijn (2009) stress that one can only measure effects when the whole programme has been developed and implemented, which means that in evaluating CBE teaching, learning and assessment should be incorporated as independent variables. Specifying competencies to be acquired by students alone, does not automatically result in the design of effective competence-based learning arrangements (Biemans et al. 2009). More is needed.

What is needed is careful planning, designing and implementing effective ways of competence-based learning that integrate relevant knowledge, skills and attitudes (which relates to the notion of integrated occupationalism as presented in Chapter 1 of this Volume), that take place in realistic and meaningful situations (related to the notion of situated professionalism; see Chapter 1 as well) (cf. Delamare Le Deist and Winterton 2005). In this regard, Watson (1991) cites Grabowski (from 1981, p. 7): 'It is relatively easy to develop lists of competencies, (it is) very time consuming and expensive to develop the training and evaluation packages based on these competencies'. This issue of 'translating' competence frameworks into curricula and instruction relates to what Lum (1999) has indicated as the friction between competence as goal of education and a competence-based education strategy.

In the remainder of this chapter, details will be presented about models that are developed to implement CBE in VET institutions. First some general models will be described and afterwards concrete guidelines on how to design CBE will be shown. These models should be taken into account when evaluating the effects of CBE, to get a good picture to what extent CBE really meets its expectations.

CBE models and implications for educational design

In this section several frameworks for CBE will be presented. This will be helpful for both scientific and practical communities by getting a grip on what CBE actually entails. The main selection criterion for these models was the comprehensive approach of competence (see Chapter 1 in this Volume).

An important observation to start the presentation of the CBE models is that CBE needs a balance between standardisation and individualisation of education. Watson (1991) described this dual character of CBE already twenty five years ago. On the one hand, standardised competencies take a central position: 1. role-relevant competencies including standards are identified and stated, 2. competencies are specified to students prior to instruction, 3. criterion-referenced measures are used to assess the level of students' competence development, and 4. a system exists for documenting the competencies developed by each student. On the other hand, in order to achieve maximum flexibility, CBE requires some form of individualised learning: 1. individualised materials and methods are used in instruction, 2. learning time is flexible, and 3. learning is guided by feedback. Knowing this duality (standardisation vs. individualisation) one can think these two characteristics are not compatible in CBE; but the opposite is true. The strength of CBE lies in the fact that these standardised competencies should be translated into the context of the individual student to become meaningful for that particular student and this translation allows for flexibility on the student level.

As shown in the following section, regardless of their different background (policy, policy evaluation, development or research), most theoretical frameworks incorporate this aforementioned duality. This is for instance visible in the model of the Inspectorate of Education (2007), which is a model for policy development and policy evaluation purposes. This model includes the following aspects: 1. integration of knowledge, skills, and attitudes; 2. orientation on acting (in the domain of the profession); 3. focus on the individual; and, 4. focus on the development of the individual's career. It is also visible in other models which originate from research. Some of these will be presented below. This presentation illustrative, and not meant as a total overview of all existing models for CBE. The models which will be presented are selected to represent different backgrounds (i.e. discipline, research vs. policy), which reveals the complexity of CBE.

First of all the model of Van den Berg and De Bruijn (2009). Based on experience and extensive research involving many different stakeholders (i.e. researchers, teachers, curriculum developers), these authors described CBE by means of the following aspects: 1. *learning by self-steering* – on the one hand, this is deemed necessary because the demands of the labour market require that graduates are able to steer their own careers; on the other hand, more self-steering fits the current developments in pedagogics – making the students responsible for their own learning process so that they are more motivated. 2. *learning in the workplace/workplace learning* – enlarging the amount of time spent in the workplace; this aspect is especially important because there is a need to bridge the gap between education and labour market. 3. *meaningful learning* – the challenge in this regard is to connect the learning outcomes of the workplace with a reflection (from a distance) and together this will make

learning more powerful and meaningful; and 4. *flexibility* – this concerns flexibility of the content of the learning trajectory and flexibility in relation to the pedagogical-didactical approach. The aspects defined by Van den Berg and De Bruijn are formulated for vocational education in general.

Secondly, in the field of health education Gruppen, Mangrulkar and Kolars (2012) described CBE as a framework for designing and implementing education that focuses on the desired performance characteristics of health care professionals. According to them, five characteristics of competence and CBE do exist:

1. competence focuses *on performance* in terms of the end product or goal state of instruction: by emphasising the results of education rather than its processes, CBE provides a significant shift in what educators and policy makers look for in judging the effectiveness of educational programmes;
2. competence reflects *expectations that are external* of the immediate instructional programme; success is determined by the individual's ability to perform up to expectations that are largely determined by stakeholders outside of the educational program itself;
3. competence is expressible in terms of measurable behaviour; assessments emphasize behavioural measures that depend on *integrating knowledge, skills and attitudinal aspects* derived from an aggregate of educational experiences and parts of the curriculum;
4. competence uses a standard for judging competence that is not dependent upon the performance of other learners; *criteria for performance standards are determined by the judgement of practitioners and educators in the field*;
5. competence informs learners and other stakeholders about what is expected from them; CBE is *transparent* and accountable to learners, policymakers and other stakeholders.

The models of Van den Berg and De Bruijn and Gruppen et al. are developed with a research purpose in mind. The crucial difference between both models is that Van den Berg and De Bruijn (2009) mainly focus on the self-regulated character of CBE by means of flexibility and self-steering (two out of four CBE aspects deal with the self-regulated nature of learning processes), whereas the focus of Gruppen et al. (2012) is on the relationship between education and practice. In general, stakeholders from practice are relevant parties, and mentioned several times in the defining characteristics of CBE.

Another research-based example of CBE frameworks is the model of Sturing, Biemans, Mulder and De Bruijn (2011), which builds on a previous model developed by Wesselink, Van den Elsen, Biemans and Mulder (2007) and Wesselink (2010) and theoretical principles as generated by Mulder (2004). The model of Sturing et al. (op cit), also known as the CCBE (Comprehensive Competence-Based Education) model, includes ten essential CBE design principles at five implementation levels (ranging from not competence-based to completely competence-based), and was validated in senior secondary vocational education by both

educational experts and teachers. The model as a whole, including the descriptions of the levels of implementation of the principles of CBE, is meant to support the development of CBE in practice. The model is the only one known to describe different levels of implementation. The so-called 'completely competence-based level' is representing the full implementation level of the given principles. The design principles and the implementation of these at the full implementation level are be presented below:

1. The study programme is based on core tasks, working processes and competencies (the qualification profile as defined with help of the labour market).
2. Complex vocational core problems (as present in the labour market) are central.
3. Learning activities take place in different concrete, meaningful vocational situations.
4. Knowledge, skills and attitudes are integrated.
5. Students are regularly assessed.
6. Students are challenged to reflect on their own learning.
7. The study programme is structured in such a way that the students increasingly self-steer their learning.
8. The study programme is flexible.
9. The guidance is adjusted to the learning needs of the students.
10. In the study programme attention is paid to learning, career and citizenship competencies.

As said, for each design principle, five implementation levels are described (referred to as 'not', 'starting to be', 'partially', 'largely' and 'completely' competence-based).Thus, in its most elaborated form, CCBE is defined by the descriptions of the fifth implementation level ('completely' competence-based) of the ten design principles (Sturing et al. 2011):

1. During the development of the study programme the qualification profile is at all times used and the programme is synchronized with practices and developments in the profession. Teachers are familiar with the qualification profile.
2. Complex vocational core problems are at all times central to the study programme and are assessed in many different contexts. The complexity of the problems increases during the study programme.
3. Participants always work (both in and outside school) individually and in teams on learning activities that take place in various meaningful, concrete practice settings. A link is always made between classroom learning and learning through practical experience.
4. Knowledge, skills and attitudes are always integrated in the learning process. Knowledge, skills and attitudes are assessed as an integrated whole.
5. Assessment takes place before, during and after the learning process and is both qualifying and focused on the competence development of students. Students determine the timing and format of assessment themselves. Representatives of vocational practice are at all times involved in the assessments.
6. Students are at all times challenged to reflect on their learning, the learning outcomes and the occupation.
7. The study programme offers at all times possibilities for self-steering. Students design their own learning process. The students' self-steering of their learning process increases during the programme. Each student is ultimately self-responsible for his/her own learning process.
8. The study programme is flexible and planned with the coach based on the characteristics of the student.

9. The teacher is a coach, mentor and expert. The teacher offers varied guidance which at all times is adjusted to the learning needs of the students. Students are stimulated to help each other.
10. Attention is paid at all times to learning, career and citizenship competencies during the study programme. These competencies are integrated in the study programme.

Although, the CCBE model as formulated above is still quite generic, the last list already contains more detailed specifications mainly because of the further elaboration of the distinct levels of CBE implementation in educational practice. Elements of the other models of CBE can be recognized in the CCBE model (i.e. self-regulated learning, relationship with practice).

When reflecting on all models, it can be concluded that both integrated occupationalism (integration of knowledge, skills and attitudes) and situated professionalism (meaningful learning, in context, more time should be spent in practice) can be recognised. Besides, there is a changing role for the individual (i.e. self-steering) and attention should be paid to the future careers of the students. As mentioned before, this could be summarized as the core of CBE in VET.

The described models show similarities (and also differences) but, even knowing these similarities, these models are still not really ready for guiding curriculum design, let alone that they are directly instrumental for teaching and learning activities and assessment. Translating competence-oriented goals into actual learning arrangements taking place in different authentic situations is crucial in the implementation of CBE. If CBE implementation gets stuck at the preparation phase and/or does not get carried into the implementation phase of actual learning arrangements, true innovation will fail and realisation of the expected benefits will not be possible (Biemans et al. 2009). Therefore, in the next section of this chapter, the CCBE principles will be further operationalized to offer more concrete guidelines that can guide the design of learning arrangements in CBE.

Operationalizing CBE by using vocational core problems

Efforts necessary to realize CBE include, among other things, defining relevant vocational core problems in order to support and connect learning and assessment in school and in the workplace. In the Netherlands, these vocational core problems are described in competence-based qualification profiles. Biemans et al. (2009) show that Dutch institutions for vocational education have made considerable efforts to design, develop and implement new competence-based learning activities and assessments based on these competence-based qualification profiles and these profiles are, at least for senior secondary vocational education, determined at national level. Compared with profiles developed in France, Germany and the UK, the Dutch qualification profiles have a dual character (Brockmann, Clarke, Méhaut and Winch 2008). They focus both on the output (competencies necessary for successful performance in practice) and input (characteristics of individuals necessary for successful performance).

Where Germany mainly focusses on the output, the UK focusses on the input. France shares the dual position of the Netherlands.

In the Netherlands, the ultimate goal behaviour, required core job tasks, professional dilemmas, relevant competencies and their specific results defined as observable performance indicators are described for all vocational core problems (i.e. sometimes labelled as critical job situations) specified for one profession (see also Gulikers, Biemans & Mulder 2009 for more examples). A vocational core problem is a description of a realistic and contextualised professional situation that involves performing a complex combination of job tasks and dealing with professional dilemmas (Biemans et al. 2009).

An example of one vocational core problem, as part of a qualification profile, is presented in table 1. The complete competence-based qualification profile contains two vocational core problems: taking care of the production and the animals (see table 1) and optimizing business activities.

Table 1. Example of a vocational core problem for the qualification profile Animal Care Specialist. This programme counts four years, senior secondary vocational education level and is comparable with EU level 5.

Vocational core problem	The animal care specialist at a dairy farm takes care of, feeds and milks the cows and takes care of their living environment in such a way that the animals stay in good condition and the working environment such that the people involved are at ease. The animal care specialist also facilitates the reproduction and breeding processes of the animals in such a way the production of planned and healthy offspring is guaranteed.
Job tasks	- Feeding animals - Take care of animals - Milk animals - Take care of environments of animals and people involved - Facilitate reproduction and breeding processes
Professional dilemmas	- Quality versus efficiency - Animal welfare - Safety versus business results
Competencies	- Decision-making and initiating activities - Collaborating and consulting - Acting ethically - Formulating and reporting - Using professional expertise - Applying relevant materials and means - Planning and organising - Producing quality - Following instructions and procedures - Dealing with pressure and setbacks

Performance indicator (example)	Feeds safely, efficiently and according to procedures held at the farm *(addressing core task 'feeding animals' and competency 'following instructions and procedures')*

In the Netherlands, the process of constructing the qualification profiles is organised at the national level. However, as stated before, these profiles do not contain any specific information for the teaching, learning and assessment activities: teachers often mention that they have not yet developed a suitable set of assignments to be carried out by students within the context of CBE. In many cases, the assignments they come up with are directly derived from the traditional learning materials meant for direct instruction. Thus, in the coming years, further development of suitable competence-based learning arrangements and activities that truly inspire students and enable them to study in a more meaningful and integrated way remains an issue of high priority. To ensure that this process is going to succeed, teachers should be supported in implementing the new learning arrangements in their own educational practice. The following section provides guidelines how competence-based learning arrangements can be designed and examples of inspiring learning environments that can be used within the context of CBE.

Further concrete guidelines to develop learning arrangements in CBE

As mentioned above, in most cases, existing qualification profiles, including relevant vocational core problems, provide the starting point for CBE. In the qualification profiles the 'what' aspects of the curriculum are described. This refers to the curriculum content in terms of essential vocational core tasks, corresponding working processes and relevant competencies with underlying knowledge, skill and attitudinal elements, or, in other words, the principles 1, 2, 4 and 10 from the CCBE model.

But how to take care of the 'how' aspects of the CCBE model, i.e. principles 3, 5, 6, 7, 8 and 9? In the following section, the process of CBE design is explained by means of the following steps: 1. development of summative competence-based assessment, 2. design of practical learning situations, 3. formulation of concrete learning question, and 4. composition of personal learning arrangement.

1. Development of summative competence-based assessment

The design of CBE starts with the development of a summative competence-based assessment corresponding to the vocational core problems (see Table 1) from the particular qualification profile. Thus, designing the assessment in not the apotheoses of curriculum development, but rather the starting point. This is a critical factor as the summative assessment is *the* most steering factor behind student learning (Dochy and McDowell 1997). These summative competence-based assessments (CBAs) should be aimed at judging whether or not a student is

competent in dealing with the vocational core problems, according to the standards expected of a starting professional (as specified in the qualification profile). To assess whether or not a student can competently deal with the vocational core problem in various situations, a competence assessment *programme* is required instead of a one-shot assessment method (Van der Vleuten and Schuwirth 2005). A competence assessment programme (Baartman, Bastiaens and Kirschner 2006) is a combination of assessment methods that together allow for a reliable and valid judgement about a students' competence. A simple guideline for developing a competence assessment programme can be offered using Miller's Pyramid (1990). Miller describes professional competence in four layers: "knows", "knows how", "shows how" and "does" level in which the lower two levels address a students' knowledge or cognitive capacities, while the two higher levels are geared towards performance. Miller makes a connection between the content of the assessment ("the what") and the assessment methods that are fit to measure this content ("the how"). Going up in the pyramid, the assessment methods increase in their authenticity in the sense of being representative of the vocational core problem (Gulikers, Kester, Kirschner & Bastiaens 2008). A simple guideline for a competence-based assessment programme is that this should include at least one assessment at the "knows" or "knows how" level of Miller's pyramid (1990) and one assessment at the "shows" or "does" level that is very authentic with respect to the vocational core problem and requires students to actually perform the vocational core problem (Baartman and Gulikers accepted). These performance assessments require careful observation by, preferably more than one assessor and assessors from practice.

The summative CBA in case of the animal care specialist could be to take the lead on a farm with animals without supervision of the farmer him- or herself for a particular period of time. The CBA programme can consist, for example, of 1. an observation of the student's performance or a video of this performance (does), 2. a logbook in which the student concretely describes all undertaken activity (does), and 3. a criterion-based interview in which an assessor asks the student critical questions about his conducted tasks, dealing with the professional dilemmas, and the reasons for performing the way he/she did (knows how), and/or 4. a knowledge test on animal deceases and symptoms and feeding/food possibilities or problems (knows).

2. *Design of practical learning situations*

Next, practical learning situations for the students should be designed that are aligned with the CBAs. These practice situations in which students are expected to develop their own competencies take a central position in the students' learning process. There should be a direct relation between the practice situations and the corresponding CBA (Gulikers et al. 2008): Students often appear to experience insufficient alignment of their school assignments, their workplace training tasks and the CBAs (Biemans et al. 2009; Gulikers et al. 2009) and this misalignment is critical for assessment quality and in turn teaching and learning quality (Gulikers, Biemans, Wesselink and Van der Wel 2013). To achieve this alignment, the practice situations should be directly derived from the particular CBA in the sense that they focus on the same vocational core problems and professional dilemmas and appeal to the

same competencies. In other words, the practice situations should be authentic as well and reflect real-life complexity. Within the context of a particular CBA, each student should be confronted with several practice situations, which together cover the whole CBA. The coach determines, together with the student, which concrete practice situations will be chosen as part of the learning process. Additional to and supportive of performing and practicing in practice situations, a supporting line of disciplinary knowledge (e.g. a course on animal diseases, symptoms and food/feeding possibilities) or routine skills training (e.g. cleaning barns or using hygiene procedures when working with animals) can be offered alongside the practical situations (Van Merriënboer 1997). However, the links between these disciplinary courses or skills training and performing professional practice situations should be explicit and is of the utmost importance, as this transfer will not automatically happen (Baartman and De Bruijn 2011). Thus, in CBE knowledge and skills courses can have a place, but not as isolated activities, but always related to and supportive of professional practice situations.

3. *Formulation of concrete learning questions*

These practice situations should lead to concrete learning questions of the individual student, which steer his or her competence development and foster active learning. In collaboration with a coach, students should be stimulated to think about: "What tasks have I already mastered and what (parts of) the tasks in my qualification profile should I pay additional attention to and practice some more?" Therefore, as part of the CBE design process, a set of possible relevant learning questions can be defined in advance related to each CBA and corresponding vocational core task. An example of a learning question is: being responsible for the sales department, how can one maximise profit and be friendly to the customers at the same time (learning question related to a critical job situation of a retail salesman)? It is the responsibility of the coach to determine, together with the student, which learning question can be addressed at what stage during the learning process.

4. *Composition of personal learning arrangement*

Next, together with his or her coach, each student should compose his or her own personal learning arrangement (consisting of various specifically designed learning activities and corresponding student assignments, tools, resources, etc. in the framework of the relevant vocational core problem), which is directly related to the student's specific learning question and specifically comprised to promote his or her own competence development. Therefore, in the design process of CBE, it is important to explicitly define possible learning questions corresponding with a particular vocational core problem (or CBA) before developing concrete learning activities. This means that educational designers take possible learning questions of students as starting point (in the preparation phase), otherwise, the design process may become too instrumental, meaning that the CBA is directly translated into more or less isolated student assignments with the risk of fragmentized learning. In this step it is crucial to try to look through the eyes of a student and not from the perspective of a discipline. If this

crucial step is taken from the disciplinary perspective the chance is big that traditional assignments will be used (again). When an educational designer looks from the viewpoint of the student, he or she will come up with assignments that are meaningful and resemble practice for the student, so it is not up to the student to integrate the obtained knowledge or skills into the CBA or vocational core problem. This integration was already clear before the start of the assignment.

In CBE, the learning questions of the students provide direction to their learning processes; it is to be expected that students who are just about to start within CBE experience difficulties with formulating their own learning questions. Coaches should support them, and a set of realistic possible learning questions could be helpful. When students become more experienced in CBE, they should be able to come up with learning questions themselves and formulate, together with their coach, relevant learning activities. Moreover, it would be preferable to design several learning activities and corresponding materials for each specified learning question. This increases the change a student can choose a learning activity that he or she appreciates the most (choosing also reflects some kind of self-directedness). As a start of the actual learning process, coach and student make a selection from the available learning activities or develop new learning activities in order to answer the student's learning questions. CBE is mainly demand-driven and flexible, however when a student starts within CBE, he or she should be supported to uptake this self-directed role step by step.

Table 2 provides an example of a concrete competence-based learning arrangement based on a CBA for Animal Care Specialist presented in Table 1. This example starts with the expected ultimate goal behaviour (as described in Table 1). Next, related practice situations are presented followed by possible relevant learning questions and corresponding possible learning activities (and learning materials).

Table 2. Example of a concrete competence-based learning arrangement based on the vocational core problem for Animal Care Specialist (the first part is the same).

Vocational core problem	The animal care specialist at a dairy farm takes care of, feeds and milks the cows and takes care of their living environment in such a way that the animals stay in good condition and the working environment such that the people involved are at ease. The animal care specialist also facilitates the reproduction and breeding processes of the animals in such a way the production of planned and healthy offspring is guaranteed.
Related practice situations (under supervision of the farmer)	- Feed the cows at a real dairy farm - Take care of the cows - Milk the cows - Take care of the environment of the cows - Facilitate reproduction and breeding processes of the cows - Integral animal care at the farm (combining the practice situations mentioned above) - Integral animal care at a different dairy farm

Possible relevant learning questions	-	How can I be sure that the cows get enough to eat and that I do not waste animal food at the same time?
	-	How do I recognise when a particular animal is not healthy and how do I take appropriate action?
	-	How do I milk the cows as efficiently as possible?
	-	How do I recognise when a particular aspect of the farm environment could have a negative influence on the cows?
	-	How can I select cows for breeding?
	-	How can I prioritize my activities when I am responsible for integral animal care at the farm?
	-	To what extent does integral animal care differ between the two farms?
Corresponding possible learning activities	-	Interview the farmer how much food the cows need exactly and provide this to the animals without spoiling
	-	Study information sources on symptoms of health problems of cows and determine to what extent such symptoms are present
	-	Try to milk the cows as efficiently as possible and analyse which factors influence milking efficiency
	-	Study information sources on environmental factors that influence animal welfare in a negative way and determine to what extent these factors are present at the farm
	-	Study material on breeding processes of cows and determine what this means for this particular farm
	-	Interview the farmer on integral animal care management at the farm and priorities in this regard and act accordingly
	-	Analyse the differences in integral animal care management at both farms and describe what these differences mean for your management priorities

To summarise, different components should be designed as part of the process of realising CBE:

1. summative competence-based assessment programmes (CBAs);
2. related practical learning situations (including supportive knowledge and skills);
3. relevant personal learning questions (already prepared for starting students);
4. corresponding learning activities and materials put together in a personal learning environment.

Table 3 provides a set of design aspects with corresponding questions for design teams to ensure the quality of the various CBE components.

Table 3. Design aspects and questions to ensure the quality of the various CBE components

CBA

•	Assessment programme	Does the combination of assessment activities offer a complete picture of students' competent performance
•	Competencies	Are all competencies defined in the CBA addressed in the other CBE components (practice situations, learning questions and learning activities)?
•	Alignment	Is the vocational core task and belonging professional dilemmas of the CBA used as starting point for the other CBE components

(practice situations, learning questions and learning activities)? That is, are all the CBE elements (e.g. CBA, vocational core problems, learning questions, learning arrangements) aligned?

Practice situations

•	Dilemmas	Do the practice situations include professional dilemmas that force the students to make choices?
•	Complexity	Are the practice situations sufficiently complex (in alignment with CBA)?
•	Variety	Are the practice situations sufficiently diverse?
•	Student level	Are the practice situations attuned to the cognitive and prior knowledge level of the students?
•	Challenging	Are the practice situations future-directed and challenging?
•	Authenticity	Are the practice situations authentic (resembling critical professional situations)?
•	Meaningful	Are the practice situations meaningful for students, school and the particular business sector?

Learning questions (composed by either educational designers or students themselves)

•	Kind of learning questions	What kind of leaning questions are students likely to come up with when facing the vocational core problem?
•	Knowledge/skills/attitudes	Are their specific knowledge, skills, or attitude components that require additional learning activities?
•	Self-assessment	Are students supported in self-assessing their strengths and weaknesses to come up with learning questions?
•	Recognisable	Are the learning questions recognisable for the students?
•	Insight/application	Are the learning questions mainly aimed at insight and application (and not at reproduction)?
•	Providing direction	Do the learning questions provide direction to the learning process?

Learning activities

•	Integration	Do the learning activities require integration of relevant knowledge elements, skills and attitudes?
•	Explicit relation to core task	If there are more or less isolated knowledge, skills or attitude training activities, are the explicitly related to and supportive of performing the vocational core problem?
•	Focus on learning results	Is it clear to what learning results the learning activities should lead?
•	Reflection	Do the learning activities lead to reflection on learning process and learning results?

Connection between the four CBE components: final crucial check

•	Connection	Are the four CBE components (CBAs – Practice situations – Learning questions – Learning activities) sufficiently connected and is the connection transparent for all parties involved (teachers, students, and workplace supervisors)?

Examples of inspiring learning environments for CBE

Within the context of the design and implementation of CBE, authentic, powerful, and inspiring learning environments are regarded as crucial (see also De Bruijn and Leeman 2011). In these learning environments, students are enabled to optimally develop their competencies for handling professional core problems (e.g. through apprenticeships, practical simulations, and project-based workplace learning; three frequently used professional learning contexts in secondary and higher vocational education programs – see for more details Khaled, Gulikers, Biemans, Van der Wel, and Mulder 2014). When looking at the educational design steps mentioned above, these learning environments should incorporate professional practice situations, allow for individual learning questions and opportunities for choosing and practicing in various learning activities. As such, these powerful, inspiring learning environments should properly prepare students for their summative competence-based assessment. Powerful learning environment in CBE, certainly in vocational education, inevitable require connectivity between learning in school and learning in the workplace (Griffiths and Guile 2003; Tynjälä 2009; Wesselink, De Jong and Biemans 2010). There are already many promising initiatives in the Netherlands but also in other countries all over the world at various educational levels in which competence-based learning environments have been developed, implemented and occasionally evaluated. In some cases, this concerns local initiatives, while, in other cases, cooperation exists at a regional or even national level (Biemans et al. 2009).

Implementing CBE requires redesigning existing education (see the four steps mentioned before): competence-based learning environments could incorporate the CCBE principles formulated earlier to ensure that actual competence development will take place. To help schools to choose and develop appropriate competence-based learning environments, a specific set of prototypical and so-called 'inspiring' learning environments was designed and evaluated by Schaafsma, Biemans and Verstegen (2007) (see Table 4). These learning environments are presented in this chapter to provide ideas of possible alternatives educational designers could think of depending on what they want to achieve in a particular learning environments (e.g. skills development, role modelling, knowledge transfer). Every inspiring learning environment described in Table 4 is more or less suitable for specific purposes. For example, the studio is good for practicing skills in groups, a masterclass aims at inspiring people via bringing innovative knowledge and insight in a certain field, and a clinic is very effective for supporting creativity, brainstorming and opportunity identification. This list of inspiring learning environments can open educational designers' eyes to the wide variety of possibilities to inspire and develop students in CBE. However, effective use of this range of inspiring learning environment requires that educational designers clearly define for what goal they are developing a learning environment. Depending on that goal, a specific prototypical learning environment is more or less suitable.

Table 4. Examples of innovative inspiring learning environments within the context of CBE

Learning environment	Description	Learning activities

Master class	Expert provides suggestions and examples and shares experiences to inspire students.	• Classes • Storytelling • Cases
Clinic	In-depth (practical) training by expert who coaches the students individually and intensively (short term; learning by doing).	• Demonstration • Exchange experiences with professionals • Practical • Course • Training • Workshop
Atelier	Creativity sessions to support students in abandoning existing conceptions and borders to find other directions and opportunities to solve problems (self-expression, intuition, stimulating environment).	• Brainstorming • Mind mapping • Storytelling • (Self-)reflection (personal development) • Inventing different scenarios for problem solving
Laboratory	Solving a real-life (technical) problem by experimenting with different solutions in a safe environment. Focus is on the development of content (i.e. product, concept or solution).	• Problem analysis • Research design • Protocols • Simulation
Academy	Transition from science to practice. Knowledge circulation from (international) research. Researchers provide students with more theoretical background and help to broaden their scope.	• Classes • Lectures • Seminars • Symposia
Studio	Students work individually or together on a problem assisted by a coach. Learning from mistakes. Focus on the importance of networking.	• Training • Teamwork • Developing routines • Presentations
Professionals Pub	Students arrange events and meetings on a special theme or problem and invite professionals and experts to share their experiences and go into debate. Students get the opportunity to network and meet new people (infotainment, incidental meetings).	• Lectures from inspiring guest speakers • Team quiz • Digital/virtual support (e.g. discussion panel)
Boxing-ring	Competitive environment in which better performance is rewarded. Students practice for a performance (contest) supported by a coach (/expert/professional). During the actual performance they should be aware of their environment and their competitor and stick to the rules.	• Training and coaching • Debate • Discussion • Management games • Simulation games • Development of innovative products

Kitchen Table	Quiet and safe environment in which (personal) experiences can be shared and there is room for self-reflection. Feedback and reflection can take place between the student and his/her coach, an expert, professional or peer student.	• Dialogue • Reflection session • Feedback (expert/ peer, 360º)
Utopia	A group of students works on a real-life case in a social context. They need to find a compromise between different stakeholders in order to find possible solutions.	• Interview • Debate • Discussion • Negotiating • Problem analysis • Presentation
Study Club	Exchanging practical experiences on a certain theme or subject. Problems or topics faced by students during their work, training period or internship can give input for organising meetings around these topics with other students and professionals or experts.	• Guest speakers • Enterprise visit • Enterprise audit • System analysis • In-depth interview ('mirror'' of professional) • Benchmarking
Expedition	By stepping out of his/her own environment, the student can learn from other perceptions which can change his/her world of view. Moving borders and changing views. This experience can give the student new understandings and other opinions and also stimulate (self-)reflection when travelling without clear goal, destination or path.	• Excursion • Study visit • Survival • Journey report • Self-reflection • Benchmarking

Next to the intended learning goals, variables such as student level, number of students, goal of the course, or teacher capabilities, influence the decision for adopting a certain learning environment. Apart from a careful selection or design process, clear communication between teachers and students about goals and procedures of the intended learning activities within the learning environments, and their link to the professional task students are working towards, is of vital importance. Finally, students should be supported by their teachers while performing these learning activities. Under these conditions, competence-based learning environments can be truly inspiring (Biemans et al. 2009).

Schaafsma, Biemans and Verstegen (2007) showed that, at the beginning of their learning trajectories, students prefer learning environments mainly characterised by external regulation (by teachers, coaches, etc.). During these learning trajectories, their preferences move in the direction of more open learning environments characterised by regulation by the students themselves. Thus, during their educational programme, the students' needs for autonomy and responsibility appear to increase and they become more capable to learn independently. This finding should be taken into account while selecting and/or designing competence-based learning environments for students working in a competence-based educational programme.

Conclusion

As stated in the introduction of this chapter, the expectations of CBE are high; students would be more motivated to finish their educational programmes and they would experience less transition problems when entering the labour market. Looking at evaluations of the implementation of competence-based qualification profiles at country level, it becomes clear that it is not sufficient to solely determine to what extent competence-based qualification profiles are implemented to be able to generate answers regarding the effectiveness of CBE. In this chapter, it is emphasised that it is necessary to take the design of the curriculum, teaching, learning and assessment into account when trying to answers questions regarding the effectiveness of CBE. By doing so, this chapter offers educational developers concrete footholds for implementing the theoretical principles that define 'ideal' CBE. Four steps are necessary for designing effective CBE: 1. Defining summative competence-based assessment programmes (CBAs), 2. Identifying related practical learning situations (including supportive knowledge and skills), 3. Formulating relevant personal learning questions, and 4. Composing corresponding learning activities and materials and putting these together in a personalized learning environment. The main message of this chapter therefore is that implementing CBE is a complex process and examining its effectiveness requires studying the actual *implementation* of the CBE principles in teaching, learning and assessment activities, and specifically the *alignment* between these elements. If these aspects are not taken into account in evaluations, they will stick at the level to what extent countries or VET institutions are able to accommodate a standard set of competencies in the educational programmes, while, as emphasized in this chapter, especially the translation into the individual level makes the learning in CBE a meaningful and powerful learning experience.

To finalize, the mentioned duality of standardisation versus individualisation of CBE should no longer be emphasized; the emphasis should be on activities that help teachers as well as individual students to find an effective balance between these two. This requires a certain degree of flexibility of the whole educational system and will result in (partly) individualised learning trajectories. This chapter offers ample opportunities for educational developers and teachers to consciously build this flexibility in in the design of the CBE curriculum. The extent to which teachers and students will succeed in creating their own learning path will determine whether CBE will be successful for individual students and as a result successful as a whole. It is to be expected that many differences will be found; each study programme (or even each student) will balance between both ends, which means that conclusions about CBE effectiveness at institutional level are hardly possible, or, as said meaningless, let alone conclusions at national or international level.

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