Chapter 11
Competence and the Alignment of Education and Work

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11.1 Introduction

The competence movement which started in psychology, testing and selection in the 1950s in the USA has influenced education policymaking and practice during the late 1960s. The essence of the movement was to align education with the world of work, a challenge which is still on the international education policymaking agenda, especially in the sectors of vocational and professional education. However, the implementation of what became known as competency- or competence-based education was not without problems.

This chapter will give an overview of the issues which are pertinent in the integrated alignment of education and work using the construct of competence. First, some early accounts will be presented regarding the concept of competence in the education literature, which we now can date back to the middle of the nineteenth century. These accounts form the foundation for current key competencies and the essence of competence-based education and professional development. As described earlier (Mulder 2014), the concept of competence was used as a pre-academic construct, as if its meaning was not yet contested. It lasted until the middle of the twentieth century, until the concept entered psychology and was originally seen as an alternative for the Freudian depth-psychological explanation of behaviour which focused on the unconsciousness.

Next, the notion of competence and alignment will be addressed, taking the theory of strategic alignment of intended learning outcomes, learning processes and assessment of learning proposed by Biggs (1999) as a starting point. The argument will be put forward that the model of strategic alignment needs to be expanded for

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vocational and professional education by adding competence frameworks as a component. These frameworks serve as a major input for the decision-making on intended learning outcomes. Furthermore, but that should be part of any model of education, the educational philosophy of the educational institution should be included. Educational philosophy serves as a kind of filter by which various (conflicting) inputs are evaluated to decide which way to go with the planning of educational programmes (Tanner and Tanner 1995).

Next, competence-based vocational and professional education is positioned in the integrated occupationalist approach of competence development. This approach is different from the behaviouristic-functionalistic approach in that it does not focus on trainable behaviours, but on generic competence frameworks which are based on occupational profiles. It is also different from the situational-professional approach, which focuses on professional development in social practices. That approach is typically applicable to continuing vocational education or professional development. Integrated occupationalist competence-based vocational and professional educational practices start with the development of a competence framework, which is typically established in consultations of the respective stakeholders in the world of education and work.

After having positioned competence-based vocational and professional education, the component of competence frameworks is elaborated, and the inputs on these frameworks are presented and discussed. An important feature of competence frameworks is that they define the destination for educational programmes.

Next, the practice of working with competence-based qualifications frameworks will be described. This works out differently for competence-oriented and competence-based educational programmes. In competence-oriented programmes, competence frameworks serve as the frame of reference for formulating the general objectives of the programme, whereas in competence-based education, competencies are the foundation of the various design steps in the process of curriculum and instructional development. In this case competencies are the clusters of knowledge, skills and attitudes which are necessary to perform core tasks or solve core problems in vocational or professional practice.

Subsequently, research on competence-based vocational education is reviewed. This review shows the variety of domains in which competence-based vocational and professional education and learning is being studied. It furthermore shows the diversity in displaying competence frameworks for the alignment of education and work.

Finally, in the last section, the conclusions of this chapter are formulated.

11.2 Early Accounts of the Meaning of Competence in Aligning Education and Work

There are early accounts of the use of competence in the educational literature. These accounts show that the early understandings of competence are still relevant and that they shaped the foundation of what now is called key competence. Aligment

of the worlds of education and work by competence frameworks is an elaboration of the original meaning of competence in educational science and practice. As early in the beginning of the twentieth century, the role of education in the development of competence has been noted. As said in the chapter on conceptions of professional competence in the *International Handbook of Research in Professional and Practice-based Learning* (Mulder 2014), the role of education in competence development was already mentioned by John Dewey and others. Dewey (1916) spoke about competency instead of competence, used the term only incidentally, and did not elaborate on the meaning of the concept. He just used it to express his thoughts about the aims of education. In current terminology, Dewey was stating that education should contribute to the development of a labour market qualification, career development, citizenship competence and self-responsible self-regulation (Langeveld 1945). Of course he used the terminology which was representative of the time of his writing. He spoke about the need for education to enable the development of 'industrial competency' so that people would get 'means of subsistence': about the democratic ideal that everybody should develop competence to choose and pursue a career, on the link between 'industrial competency' and 'good citizenship', and the difference between 'carrying out the plans of others and in forming one's own'.

From the phrases in the book of Dewey in which he used the term competency, it can be seen that he used it in a way that was and still is described in the dictionaries: competence as the ability to perform and to create a livelihood and the right to act in a certain field. Although Dewey's use of the concept of competency is prone to competence as a performance requirement, the judicial meaning of competence is linked to his notion that education should contribute to the realisation of a democratic society and that schooling of people is important so that they can choose their own career. As will be clear, these thoughts of Dewey strongly related to current key competencies in the fields of career, citizenship and self-regulation competence.

Accounts of the concept of competence can be found in other and earlier sources as well. As already stated in an earlier publication (Mulder and Pachuau 2011, 397), a committee from the UK under the leadership of Childs went on a study tour to the USA and Canada to learn about agricultural education. This study tour took place in the early twentieth century, and the report of the committee appeared in 1910, a couple of years before the key publication of Dewey on education and democracy. The use of the term competence was however much broader than in the book of Dewey. In the report (Childs 1910), the concept of competence was already used to refer to issues in educational and professional practice which are still relevant: the competence of farmers (which can be extended to all occupations and professions), teachers and assessors and competence in practical farm operations, science and management. The report even contains the word 'incompetence', indicating that there were a lot of workers and practices in agriculture of which the level of competence was insufficient.

An even earlier source of the use of the adjective 'competent' is the book *A History of Agricultural Education in the United States 1785–1925* of True (1929) (as a side remark: copies of this 460 page book could be procured for 1 US dollar at

that time). Actually it is not a surprise that these early accounts of 'competent', 'competence' and 'competency' are situated in the history of agricultural education, as the development of agricultural vocational-technical education (ATVET) and higher agricultural education (HAE) preceded the development of industrial (career-technical) education and service-oriented education (in domains such as banking, accountancy, insurance, management, purchasing, marketing and communication). Similar accounts may also be found in the history of healthcare education.

In the book of True (op cit), there are various places in which persons, teachers or assistants who are or need to be appointed to conduct educational duties are referred to as being, or having to be, 'competent'. In his description of the movement towards agricultural education in the USA, he describes a certain amount of agencies that he saw were supportive in the establishment of this education sector. There were various types of agencies, one being the State Board of Agriculture. One of these boards, the State Board of Agriculture of Massachusetts, appointed a committee which had the task to develop a manual for teaching agriculture in schools and to promote agriculture by public lectures. The phrase which is interesting here comes from a committee meeting in which the manual *The Progressive Farmer* was commended and in which the committee reported 'that studies of this description might be attended to with much benefit under competent teachers'. The committee meeting was held on January 12, 1853.

The book also describes the work of Eaton, who was a lecturer and appointed by the private college 'The Rensselaer Institute' at Troy, New York. The leadership of the college noted the remarkable teaching approach of Eaton. He did not use an expository method (by showing specimens and giving demonstrations) but he used a productive and constructive approach in which he invited students to collect samples in the field and to construct simple apparatus to do the tests. He suggested that this kind of education should be implemented in small groups of five students who should give lectures and do experiments, '… under the immediate direction of a professor or a competent assistant. Thus, by a term of labour, like apprentices to a trade, they are to become operative chemists' (op cit, 39–42). It is interesting to note that Eaton used the adjective competent for the assistants and not for the professors, implying that they are competent by their education, experience and position.

It is remarkable that in this book already, there is a strong link between the notion of competence and the role of teachers and professional development of teachers. Not all teachers at that time were fully capable of teaching agriculture, and one of the difficulties was the implementation of practice training and working with practical projects. Teacher training institutes were becoming active in establishing continuing teacher professional development courses. This is also visible in a report of the Federal Board for Vocational Education for 1924, in which an account of continuing education of teachers in the field of agriculture represents an early example of competence-based teacher professional development:

> It ordinarily means individual instruction of the teacher at the school he serves by a competent person whose duty it is to carry on such work where needed. It implies going here, there, and everywhere in a State where a teacher is not doing the desired kind of work, and

> staying with him, or going back to him until he gains enough additional knowledge and skill to meet his problems more efficiently. The third effective means for the professional improvement of agricultural teachers in service is the State and sectional meetings of agricultural teachers for conference, demonstration, and practice. (op cit, p. 379)

Early accounts of the concept of competence in the work of Dewey, Childs and True can be characterised as pre-scientific and pre-institutional. They are accounts in which the words competent, competence and competency were used without all reflections about those words as academic constructs in education, although there are accounts in the history of law, which indicate that the competence of law professionals and courts was already a professional and institutional issue at the end of the nineteenth century (Mulder 2014).

11.3 Competence and Strategic Alignment

As said, the early accounts of competence in the educational literature form the foundation of the current discussions about core competencies. Of course, in the course of time, many new competence domains have emerged. But the idea that education should provide competence to get means of subsistence, or in current terminology, prepare students for a labour market relevant qualification, is as a relevant as it was hundred years and more ago, and forms the heart of contemporary national and international vocational and professional education policy development. This section will elaborate these thoughts by linking societal relevance of vocational and professional education which is articulated by competence frameworks to educational alignment theory as proposed by Biggs (1999). Alignment is seen here as the relational positioning and adjustment of the constituting elements of education within the wider context of work and society, in such a way that the elements of education are strategically 'in line' with one another and meaningful in the relationship between education and work. Competence-oriented education is education of which the general aim is to develop more or less specifically formulated competencies. The difference between competence-oriented and competence-based education will be further elaborated later in this chapter in the section on 'Working with competence-based qualifications frameworks'.

Alignment, and especially strategic alignment, is emphasised by Biggs (1999) as an important characteristic of education. Biggs stressed that deciding upon a student assessment strategy depends on the question of what the intended learning outcomes are (cf. Tyler 1949). Without a good definition and analysis of these outcomes, student assessment can be totally invalid. For instance, if an essential intended learning outcome is to be able to defend a proposition in a public dissertation defence, a PhD student should not just be assessed by writing a proposition; he or she needs to be trained in this in a near-authentic assessment situation (e.g. in a staff or PhD student meeting), thus simulating the social context in which the desired performance can be practised. Like the idea that competence plays a certain role in education and society, the idea that alignment is important is not new. Various

authors within the educational sciences have suggested that multilateral adjustment of key components of the education and learning process is essential. In fact, this idea is the essence of whole models of education or teaching, in which many factors are included, as they all have a certain influence on what is happening in education and learning, and the ultimate learning results in terms of constructed knowledge. An example of this view on the internal relationships between educational objectives, learning experiences, the organisation of education and the evaluation and improvement of education can be found in the work of Tyler (1949). Comparable components of education were later termed as the commonplaces of education or the curriculum (Schwab 1969, 1971, 1973; Goodlad 1984), stressing again the importance of the relationships between these components and the necessity for multi-stakeholder deliberation (Walker 1990) to realise practical solutions for contextualised and thus specific educational challenges.

Coming back to the strategic alignment theory of Biggs, he distinguishes three core concepts which constitute education: the intended learning outcomes, learning and assessment. The core of his theory is, as stated, that these three components are mutually adjusted so as to avoid contradictions between the components. His idea is that learning consists of appropriate learning activities which lead to actual (emerging) learning outcomes. Learning activities are aligned to the intended learning outcomes so that they will result in the desired learning results. Learning processes and results are being tested by assessments which are based on the definition of the intended learning outcomes to establish alignment. So learning, intended learning outcomes and assessment need to be all aligned with one another. Sometimes, the theory of Biggs is used to stress the importance of 'reverse' thinking about educational design, which means that educational design processes should not begin with specifying the intended learning outcomes for learning processes, but that the outcomes should be linked to the assessment strategy and methods first. This is then underlined by the fact that assessment strategies tend to influence the way students prepare for the exams and thus the way in which they learn. This backwash effect should not lead to overemphasising the role of assessment and to an 'assessment first' practice, as it is still the intended learning outcomes that should set the course for an educational programme and not the assessment strategies. The assessment strategies have to follow the intended learning outcomes and precisely measure the achievement of the intended learning outcomes. These considerations, amongst others, have led certain educational researchers to advocate cyclical educational design processes with various iterations before implementing educational programmes (Plomp and Nieveen 2013).

In the field of vocational and professional education, external alignment is important to warrant a productive relationship between education and work or (the international) society at large. Vocational and professional (higher) education have often been accused of being 'irrelevant'. Critiques of employer associations, like 'these graduates (of career-technical education) cannot even hold a hammer', still

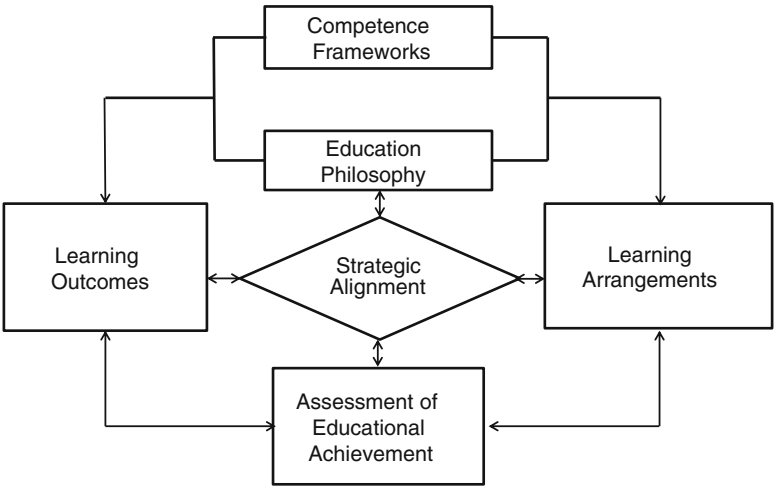

Fig. 11.1 Broadening the theory of strategic alignment for vocational and professional education (After Biggs 1999)

echo in many minds of VET experts. Therefore, in VET and higher professional education, many attempts have been undertaken to strengthen the preparation of graduates for the labour market and society. Already as early in the 1970s, projects started in the USA under the label of competency-based education. The aim of these projects was to deliberately try to get educational programmes aligned with the needs of society. These early attempts to develop and implement competency-based educational programmes are often attributed to shocks in the perception of national achievements. A good example of this is the Sputnik affair, which showed that Russia was more advanced in rocket science than the USA (see Chap. 12 of Barrick, in this volume). This perception led to many efforts in the USA to raise the level of science education and to improve the relationship between education and the world of work (Grant et al. 1979).

To underline this necessary external orientation and outside-in thinking in vocational and professional education, it is proposed to extend the model of Biggs (see Fig. 11.1).

Two components are added to the alignment model of Biggs (the intended learning outcomes, learning activities and assessment of educational achievement), which are competence frameworks as the basis for the definition of learning outcomes and the educational philosophy, based on which decisions are made about the educational objectives, learning processes and assessment strategies, of course within the legal frameworks of the educational institutions.

Two remarks need to be made regarding the additions of the two components in the model.

Firstly, whereas the Biggs, model does not elaborate how intended learning outcomes are developed, it is essential to pay attention to this, which can be done by weighing the various inputs against the institutional educational philosophy. In that sense, the educational philosophy acts as a normative filter by which potential external forces or changes in current practice are being evaluated. This reflects the professional autonomy of the educational institution and its teaching staff. They do not have to take inputs from the outside world for granted; they have their own responsibility of interpreting what is going on outside the institution and deliberate on possible and wishful adjustments of the educational practice.

Secondly, competence frameworks do not 'dictate' the content of intended learning outcomes and assessments. In other words, the model is not deterministic. As said, during deliberations about the educational programmes, the learning of students and the assessment of their achievements, there is a dynamic relationship between these factors and the emerging state of the world of work or society at large. Also, graduates not only need to be able to comply with the requirements of the labour market and their jobs, they also need to be able to contribute to innovation. Therefore, students not only be able to comply with conditions set by employers, they also need innovation competence, not only aimed at improvement but also on transformation where needed.

In this section both competence- and competency-based education are mentioned. The question however is whether they are the same. Generally speaking, competence is defined as the generic capability of people to perform tasks adequately and competency as an element of competence. It that sense, a skilful professional *is* competent and *possesses* a series of competencies. For instance, an assistant professor is called competent if he/she can teach, supervise and publish and conduct acquisition, organisational and societal tasks to an expected level. One of the competencies of this assistant professor is to write an authentic paper for a Q1 journal or to contribute to the further development of the quality of the course he/she is teaching. However, in the literature and daily practice, authors use competence, competency, competences and competencies interchangeably.

11.4 Competence-based Vocational and Professional Education: Integrated Occupationalism

As stated earlier (see Chap. 1 in this volume and Mulder 2014), three approaches of competence can be distinguished: (1) competence and behaviouristic functionalism, (2) competence as integrated occupationalism, and (3) competence as situated professionalism. The first approach dominated the rise of the competence movement in the USA and was related to parallel innovations like modular education and mastery education. The essence was that competence lists were translated in detailed educational elements which were not sufficiently coherent. The third approach predominantly pertains to continuing professional development and stresses the development

of contextualised professional knowledge. The second approach is characteristic of generic or comprehensive approaches of competence-based vocational and professional education. In this approach, competence frameworks are the starting point of curriculum development, the design of learning and instruction, as well as the development of educational tests or assessments. For the alignment of assessments, the pyramid of Miller (1990) is often used, which distinguishes four levels of assessment: (1) knows (knowledge), (2) knows how (competence), (3) shows how (performance), and (4) does (action). Whereas levels 3 and 4 actually both involve performance (it is difficult to show how one does things without actual performance), the four levels have implications for measuring competence. The difference between levels 3 and 4 assessment is that performance is assessed in simulated situations, for instance, with simulation patients (level 3) or in real situations with real patients (level 4).

Competence-based vocational and professional education which can be positioned in the integrated occupationalist approach typically uses competence frameworks as the starting point of macro- (programme and course level) and micro- (lesson and activity) design. The competencies which are included in the frameworks should be of integrative nature, thus enabling the performance of a wide variety of tasks (including new ones) and solving various problems. They should also include statements of knowledge, skills and attitudes, which can be acquired in inspiring and productive learning arrangements.

11.5 Competence Frameworks: Destinations of Educational Programmes

Competence frameworks serve as a programme of requirements for a certain occupation or profession. These frameworks are being used for curriculum development. Such curriculum development is a process of political negotiation and decision-making, whether for a national or an institutional curriculum.

The development of competence frameworks is also a process of negotiated meaning. Just like curriculum development, it is by no means a technocratic or algorithmic process. It involves a series of inputs and stakeholders (see Fig. 11.2).

As said, the process of competence framework development is essentially a social process, which is characterised by social policymaking and negotiation, It is not so much the result of pure empirical research. As such, a competence framework is a normative product and serves as an agreement or a regulation. Therefore, competence frameworks are often endorsed by the key stakeholders in the respective sector, generally referred to as sectoral organisations, which can comprise employers' associations, trade unions, related professional associations and governmental and non-governmental institutions.

Important input factors which can be distinguished are the economy, research, society and politics. To begin with the latter, politics allocates resources, decides

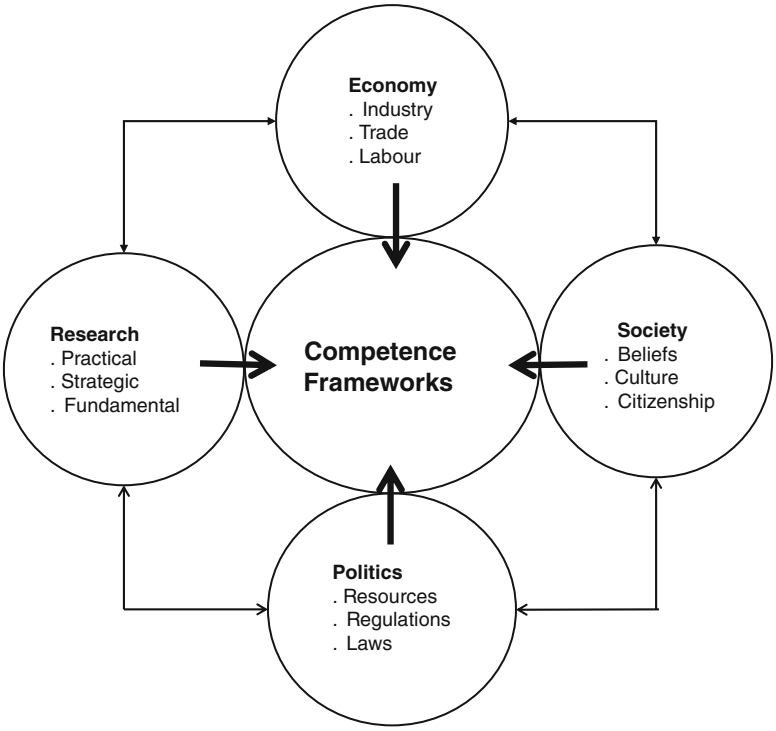

Fig. 11.2 Inputs for occupational competence frameworks for vocational and professional education

upon regulations and enacts laws which influence social practice, including occupations and professions.

The emergent economy and more specifically the industrial sectors, with their state of technological development, trade organisations and labour associations, influence the demand for competence and have influence on the development of competence frameworks.

Society finally influences the development of competence frameworks via societal beliefs, cultural norms and views on citizenship. This all relates to legal frameworks and spiritual beliefs as well, which obviously vary in diversity.

In the literature numerous competence frameworks have been proposed, under the labels 21st century skills, essential learning outcomes, student outcomes, and global competencies. A sample of these is the following.

In the enGauge 21st Century Skills model for 21st Century Learners of the North Central Regional Educational Laboratory and the Metiri Group, four categories of these skills are included: digital-age literacy (e.g. basic, scientific, economic, and technological literacies), inventive thinking (e.g. adaptability, managing complexity, and self-direction), effective communication (e.g. teaming, collaboration and interpersonal skills),and high productivity (prioritizing, planning, and managing for results) (NCREL 2003).

The Association of American Colleges and Universities (AACU 2008) developed essential learning outcomes, and presented these in a model under four headings: knowledge of human cultures and the physical and natural world, intellectual and practical skills, personal and social responsibility, and integrative learning.

The P21 Framework for 21st Century Learning includes student outcomes in the categories core subjects, 21st century themes, learning and innovation skills, information, media and technology skills, and life and career skills (P21 2015).

Vora (2015) proposed twelve professional leadership competencies for the so-called VUCA world, which means the fundamentally Vulnerable, Uncertain, Complex and Ambiguous world. These leadership competencies are very closely related to some of the ones presented under the heading of Competence 3.0 in Chap. 50. The list includes: 'Develop an adaptive mindset, have a vision, embrace abundance mindset, weave ecosystems for human engagement, anticipate and create change, self-awareness, be an agile learner, network and collaborate, relentlessly focus on customer, develop people, design for the future, and constantly clarify and communicate' (Vora 2015).

The OECD (2016) developed a global competency model for an inclusive world, which includes disciplinary knowledge, interdisciplinary knowledge, practical knowledge, cognitive and meta-cognitive skills, social and emotional skills, physical and practical skills and attitudes and values.

None of these competence frameworks however are directly linked to vocational and professional education. They are related to general education and lifelong learning.

At national, institutional and programme levels, there are various instruments which are being used to align vocational and professional education demand and supply. Examples of this at programme level are the working field committees of educational programmes, alumni surveys and education quality management procedures such as critical self-reporting, visitation and accreditation. At national level skills observatories and labour market analyses help. All have a continuous monitoring function and give information about possible discrepancies between what is offered in educational institutions and needed in society, the labour market, occupations, professions and organisations.

11.6 Working with Competence-based Qualifications Frameworks

If competence frameworks are available, the question is how these are used to plan or redesign education to contribute to the development of competence. Here, a distinction has to be made between competence-oriented and competence-based education.

Competence-oriented education is education for which a competence framework is developed which serves as the dot on the horizon. The framework is taken to formulate intended learning outcomes and to align assessment strategies and methods, but the organisation of the learning processes is largely untouched. Principles of social constructivism and activating pedagogy can be used to plan learning activities.

Competence-based education is education for which a competence framework is the foundation of the educational programme. The framework serves to identify core tasks within the occupation or profession, and for these essential competencies are defined. The competencies always consist of clusters of knowledge, skills and attitudes.

So where competence-oriented education uses competence frameworks as destinations, competence-based education uses these as road maps. Competencies are integrated in the curriculum and instructional development and preparation process. Therefore, competence-based education is a much deeper application of using the competence philosophy in education than in competence-oriented education.

An institutionalised example of a competence framework which is typically used in competence-oriented educational programmes is the European Qualifications Framework (EQF), which includes vocational and professional education. The meaning of competence in the European Qualifications Framework as indicated above is related to learning outcomes aimed at achieving certain levels of responsibility and autonomy. This EQF distinguishes eight levels of education, ranging from elementary education to higher and PhD education, and serves as a reference framework for these levels of education throughout the EU. The 'competences' in the EQF are spelled out as follows (source: https://ec.europa.eu/ploteus/content/descriptors–page):

1. Work or study under direct supervision in a structured context.
2. Work or study under supervision with some autonomy.
3. Take responsibility for completion of tasks in work or study; adapt own behaviour to circumstances in solving problems.
4. Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities.
5. Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others.
6. Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups.
7. Manage and transform work or study contexts that are complex, are unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
8. Demonstrate substantial authority, innovation and autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research.

Whereas all education systems in all member states have to grade the levels of their programmes using the EQF, not all have used this to implement competence-based education. Nevertheless, competence levels are defined within the EQF, and

as such, all educational programmes within the EU have to take these levels into account when aligning their qualifications frameworks. So, these programmes are related to the generic competence levels within the EQF and thus can be regarded as competence-oriented. However, this competence orientation is limited, as the EQF comprises knowledge and skills levels as well. They are positioned next to the competence levels (see Mulder 2012). Given the definition of competence used earlier in this volume (Mulder and Winterton 2016, Chap. 1, in this volume), this positioning of competence is at least remarkable, as competence is seen here as detached from knowledge and skills, whereas competence itself is made up of knowledge, skills and attitudes. It is as if in the EQF, competence is something which is comparable to attitudes, but it is not; it is the level at which a graduate is expected to work independently and self-responsibly.

The institutionalisation of competence did not happen without problems, which has been described in a very detailed way by Winterton (2011) in his piece regarding the genesis of the European Qualifications Framework. He has shown that in the course of the years, various trade-offs have emerged. One of these, a major one, is that various member states have decided to follow their own preference in defining the respective national qualifications frameworks. Germany, for instance, had difficulties with accepting the division of qualifications in knowledge, skills and competences categories, as is the case in the EQF. It uses the generic understanding of competence as has been expressed in the competence definition section above. 'Der Kompetenzbegriff spielt im DQR (*the German Qualifications Framework*, editors) eine zentrale Rolle. Er steht nicht – wie im EQR – neben den Kenntnissen und Fertigkeiten, sondern bildet die Klammer für alle betrachteten Lernergebnisse' (Deutscher Qualifikationsrahmen für Lebenslanges Lernen 2013), which means that in the German education system, competence is being perceived at overarching capability and not placed next to knowledge and skills (Kenntnissen und Fertigkeiten). Competence embraces all intended learning outcomes.

The English version of the German Qualifications Framework uses the plural 'competences', which however is a translation of the plural German 'Kompetenzen', which should be translated as competencies, but this actually is a detail. Most important is that competence itself is seen as the overarching integrative set of capabilities which are needed for vocational and professional practice and for effective and productive performance.

To elaborate the German example a bit more, especially regarding the way in which competence domains are being defined, it can be seen that the DQR distinguishes two competence domains: (1) professional competence and (2) personal competence. Professional competence is divided into 1.1 knowledge and 1.2 skills, for long the essence of vocational and professional education, and personal competence into 2.1 social competence and 2.2 autonomy. Below DQR level 4 is presented (source: Deutscher Qualifikationsrahmen für Lebenslanges Lernen 2013, English version: German EQF Referencing Report) (Table 11.1).

It is also interesting to look at the French NQF, which is actually not phrased as a national qualifications framework, but as a national certification framework (Commission Nationale de Certification Professionnelle 2010). The group which

Table 11.1 German Qualifications Framework, level 4

Level 4			
Be in possession of competences for the autonomous planning and processing of technical tasks assigned within a comprehensive field of study or field of occupational activity subject to change			
Professional competence		**Personal competence**	
Knowledge	**Skills**	**Social competence**	**Autonomy**[a]
Be in possession of deeper general knowledge or theoretical professional knowledge within a field of study or field of occupational activity	Be in possession of a broad spectrum of cognitive and practical skills which facilitate autonomous preparation of tasks and problem-solving and the assessment of work results and processes according to consideration to alternative courses of action and reciprocal effects with neighbouring areas. Provide transfers of methods and solutions	Help shape the work within a group and the learning or working environment of such a group and offer ongoing support. Justify processes and results. Provide comprehensive communication on facts and circumstances	Set own learning and work objectives, reflect on and assess such objectives and take responsibility for them

[a]The levels of autonomy are the competences distinguished within the EQF

has been working on the referencing of the French national list of certifications with the EQF has reported the following difficulties. First of all, France has a national certification framework which is more oriented towards the labour market than towards education or 'knowledge' as the group has put it. Secondly it appeared to be difficult to link certain certifications to certain levels within the EQF. Thirdly, the group noted that while working on the referencing exercise, the French list of certifications was discussed and further developed, and by doing this, it was stated that efforts would be made to make the list of certifications more coherent and transparent, like the qualification levels in the EQF.

The UK (Qualifications and Curriculum Development Agency 2010) also uses its own way of formatting its national qualifications frameworks. The plural frameworks is being used here, as within the UK, there are different frameworks for England and Northern Ireland (QCF), Wales (CQFW) and Scotland (SCQF). Within the UK, the different qualifications frameworks also carry the concept of 'credit' in their titles. The QCF is the Qualifications and Credit Framework, as said, for England and Northern Ireland. It contains summary statements, knowledge and understanding, application and action and autonomy and accountability headings. It is remarkable that the term 'competence' is totally absent from the descriptors of the reference levels, which may be the effect of the skills development agenda in the UK. However, at the semantic level, the summary statements and the description of

the autonomy and accountability levels in the QCF can be compared with the descriptions of the competences in the EQF.

Level	Summary	Knowledge and understanding	Application and action	Autonomy and accountability
Level 4	Achievement at level 4 reflects the ability to identify and use relevant understanding, methods and skills to address problems that are well defined but complex and nonroutine. It includes taking responsibility for overall courses of action as well as exercising autonomy and judgement within fairly broad parameters. It also reflects understanding of different perspectives or approaches within an area of study or work	Use practical, theoretical or technical understanding to address problems that are well defined but complex and nonroutine. Analyse, interpret and evaluate relevant information and ideas. Be aware of the nature and approximate scope of the area of study or work. Have an informed awareness of different perspectives or approaches within the area of study or work	Address problems that are complex and nonroutine while normally fairly well defined. Identify, adapt and use appropriate methods and skills. Initiate and use appropriate investigation to inform actions. Review the effectiveness and appropriateness of methods, actions and results	Take responsibility for courses of action, including, where relevant, responsibility for the work of others. Exercise autonomy and judgement within broad but generally well-defined parameters

Although the wording is not exactly the same, it is clear that the level 4 summary, autonomy and accountability descriptions within the QCF are similar to the EQF level 4 competence description. Given the definition of competence used in this volume, the QCF descriptors' knowledge and understanding, application and action and autonomy and accountability would all fall under the umbrella concept of (generic) competence.

Although the development of national qualifications frameworks was not easy and a time-consuming process, according to a Cedefop study, a total of 38 countries developed a NFQ before early 2015; these countries were the 28 EU member states, Albania, Bosnia and Herzegovine, the former Yugoslav Republic of Macedonia, Iceland, Liechtenstein, Montenegro, Norway, Serbia, Switzerland and Turkey (Cedefop 2015). It is clear that there are various differences between the frameworks. These differences will become more evident in part II of this volume, in which competence-based education is presented as a global innovation with multiple morphologies.

The differences are further extended to sectoral qualifications frameworks. A sectoral, or a domain-specific, competence-based qualifications framework can consist of descriptions of work processes to which competencies are linked and work activities are being specified. A domain-specific qualifications framework is used to develop curriculum profiles by identifying core tasks, core problems or core work processes in the framework and selecting these as the building blocks of the curriculum. Subject matter from different disciplines and practical learning tasks is then combined to teach a curriculum unit to the students. Assessment is being done at the level of the core task, problem or work process, preferably in an authentic or a practice simulation situation. Typically, this integrated or generic form of assessment takes it that knowledge elements and skills do not need to be tested in isolation, as they are all integrated in the core task, problem or work process, which in essence may be true, especially when higher levels of complexity are involved. At a lower level, this may be incorrect as via imitation students may be able to perform tasks within understanding the reasons behind the desired performance. This is why understanding is checked by asking students to explain why they perform a certain task in a certain way, although the level of verbalising reasons to justify practical activity may also be limited at lower levels of education.

This approach of identifying work processes and activities and linking these with generic competencies has been followed in the Netherlands, which was quite problematic, as a generic set of competencies was chosen from which a selection of specific competencies was taken, such as ‘analysing’ and ‘communication’. As generic competencies are addressed in a variety of working processes and activities, the acquisition of these competencies is repeated, broadened and deepened over time. However, testing generic competencies appeared to be rather difficult and was only possible by specifying the content of the tasks to be studied. The mistake which was made is that generic competencies were linked to work processes and activities, whereas true competence-based education starts with identifying competencies which are task or problem oriented.

11.7 Research on Competence Frameworks and Competence-based Education

There have been a substantial number of studies on competence frameworks, some of which are reviewed below.

First of all in the field of purchasing, Mulder et al. (2005) developed purchasing profiles for this stratified occupational field. They distinguished several roles in purchasing, such as assistant buyer, buyer, senior buyer and purchasing manager. For each of these roles, a competence framework was composed.

In the field of agricultural extension, Karbasioun et al. (2007) studied the competence profiles of instructors and consultants for integrated rural development (or agricultural and rural extension). The first study was conducted in Iran and the second in Korea.

On communication about HIV/AIDS in agricultural advisory work, Brinkman et al. (2007) developed a competence framework (in the form of competence statements) for rural development professionals in Africa. This project was situated in the international development cooperation context.

On entrepreneurship Mulder et al. (2007), Lans (2009), and Lans et al. (2008a, b, 2010, 2014) studied entrepreneurship competence by defining a competence profile of entrepreneurs in small- and medium-sized enterprises in greenhouse horticulture. They showed that competence assessments can also be used with farmer-owners, who discovered that they possessed competence profiles; that these were related to their performance; that they can be developed; that their co-workers have competence profiles too, which can be developed too; and that they can play an active role in that by transforming jobs into workplace learning practices. Interesting to see is that desired competencies actually possessed by the entrepreneurs are the following (listed from high to low proficiency): organising (highest), problem analysis, leadership, conceptual thinking, persuasiveness, communication, strategic thinking, planning, result orientation, negotiating, teamwork, market orientation, networking, judgement, vision, general awareness, management control, value clarification, personnel management and international orientation (lowest). The study showed that there is a lot of room for competence improvement. Related to this research, Karimi (2014) studied entrepreneurship education in universities in Iran based on the theory of planned behaviour.

Regarding open innovation, Du Chatenier (2009) and Du Chatenier et al. (2009; 2010) have been studying open innovation competence. Open innovation is about the creation of innovations in which professionals of different organisations cooperate. An open innovation is unique in terms of competence as it relies much more on inter-organisational trust and therefore is challenging in terms of intellectual property, knowledge sharing and assuring mutual benefits. The study was conducted by using experts and representatives of open innovation teams in industry. The study resulted in a competence framework of open innovation professionals.

Regarding sustainable development, Wesselink and Wals (2011) developed a competence profile of educators in environmental education organisations. In the field of teacher education, more especially on science teaching, Alake et al. (2014) developed a competence framework of beginning elementary school teachers who are expected to teach science. Amongst other things, she compared the American standards which exist for this with the standards she developed with a group of experts in the Netherlands.

Van der Heide and Mulder (2007) developed an occupational profile for professionals in the field of floriculture in Uganda, in which the floriculture profession was stratified in farm management, departmental management and supervision. This framework was used in curriculum redesign for floriculture at the level of a college and a university (Mulder and Gulikers 2011; Mulder and Kintu 2013). It was used in a subsequent study in Ethiopia and is currently being used in a study in Kenya.

Khaled (2014) studied competence development in practical training provided by a practical training centre in the field of agriculture.

Osagie et al. (2014) studied individual competencies for corporate social responsibility in organisations. Their study proceeds with the question as to what extent notions of the learning organisation (Tjepkema et al. 2002) are related to implementation of principles and policies of corporate social responsibility.

Also, the study of Seuneke et al. (2013) needs to be mentioned, who have analysed the consequences of multifunctional farming for farm household competencies. Their study shows that competencies needed for multifunctionality depend on the strategic choices of the farm owners-managers.

In the field of interdisciplinary work and learning, Spelt et al. (2009, 2015) studied interdisciplinarity competence development by reviewing and implementing educational design rules in food quality management education.

Popov (2013) studied cooperation in international student groups and saw multicultural cooperation competence as a global competence domain (OECD 2016) of utmost importance for mutual understanding, respect and the possibility to effectively cooperate. This study identified important cultural factors that play a role in computer-supported learning in interculturally mixed student groups.

The study of Oonk et al. (2011) is focused on rural development and regional planning issues which are addressed in multi-stakeholder groups, which not only consist of extension workers or researchers but also of representatives of regional authorities or non-governmental organisations (NGOs), university lecturers and students. The groups are learning groups, in which students can do their education projects. This regional learning method is a kind of boundary-crossing hybrid learning arrangement (Cremers et al. 2014) in which education, research, development, entrepreneurship and governance all come together.

Finally, the work of Noroozi (Noroozi et al. 2013a, b, c) is sharply focused on the development of argumentation competence, which is essential in professional practice. He studied this in the theoretical framework of social constructivism and via the analysis of group work on computer-supported collaborative learning platforms.

The formats of the competence frameworks mentioned vary. But a common characteristic is that they all move away from the typical laundry lists of competencies which were created in the 1970s. They tend to be more holistic and avoid overspecification. As competence frameworks they are quite open and flexible.

Research on competence frameworks and competence-based education fits within vocational and professional education research. This was shown in reviews of VET research based on papers presented in the Vocational Education and Training Research Network (VETNET) of the European Conference of Educational Research (ECER) in 2011 in Berlin (Mulder and Roelofs 2012) and 2012 in Cádiz (Mulder and Roelofs 2013), in a number of journals in those years and in the Web of Science in 2012 as indexed by the Social Science Citation Index. A comparison of the 2011 and 2012 reviews on curriculum, learning, instruction and assessment research was presented at the Annual Meeting of the American Educational Research Association in 2014 in Philadelphia (Mulder and Roelofs 2014), in which competence studies were also featured.

11.8 Conclusions

This chapter started with early accounts of the use of the competence concept in education and stated that these served as foundations for the current key competence thinking and alignment theory. It then discussed the concept of competence in relation to the theory of alignment of education and work, especially focusing on competence-based vocational and professional education. The notion that some alignment is necessary in vocational and professional education is not contested anymore, although the development of generic knowledge and skills remains important. For these generic competencies the frameworks of 21st century skills, essential learning outcomes, student outcomes, and global competencies, as described in section 11.5, can be used as a source of inspiration. Vocational and professional education itself needs dedicated competence frameworks. The chapter argued that alignment with competence frameworks is important to guarantee the societal and socio-economic relevance of programmes in vocational and professional education. Without any alignment graduates will not get an adequate starting qualification for the labour market and face difficulties of securing employment and career development. The chapter also argued that institutions for vocational and professional education have the responsibility to evaluate competence frameworks based on their view on the role of education in society. The theory of alignment was therefore extended with two components: competence frameworks and educational philosophy.

The chapter also pointed out that implementation conditions may hamper the quality of competence-based educational programmes. There have been examples that austerity measures such as less instruction, larger classes and over-reliance on self-regulated learning were 'sold' under the then attractive label of competence-based education. However, it can be concluded that when competence-based education means that students will acquire competencies as clusters of knowledge, skills and attitudes and that they will learn to practise these in authentic or simulated authentic contexts, there is no way of making the educational programme cheaper. Including practicums and experience in practice takes ample attention for resources, organisation and commitment.

The chapter positioned competence-based vocational and professional education in the 'integrated occupational' approach, implying a comprehensive view on competence and competence frameworks which serve as the basis for developing and planning a competence-based curriculum, competence-based instruction and authentic assessment.

Furthermore, working with competence-based qualifications frameworks was elaborated, and it was shown that all EU member states now work with national qualifications frameworks (in which competencies are integrated) (Cedefop 2015). Differences in national approaches were highlighted, which are further described in the chapters in part II. Finally, a concise review of research on competence frameworks was presented. Here it can be concluded that more research is needed on the actual implementation and the long-term effects of competence-based educational innovations. This research, however, is difficult because of the long period that goes

by before an educational programme is redesigned using principles of competence-based vocational and professional education, before it is implemented and before the first graduates enter the labour market. Longitudinal studies are needed for this, which measure the activities carried out, practices realised and results achieved by more and less competence-based programmes. This requires monitoring and guided research on curriculum (re-) design, educational implementation and competence assessment in practice.

Finally, it is concluded that no matter what educational theory one appreciates or what principles one follows, both advocates and opponents of competence-based education theory will agree that education should not purposefully develop incompetence Using the expanded alignment approach in vocational and professional education will help to increase the relevance of curricula, sharpen the focus of competence acquisition of students, and strengthen the trustworthiness of competence profiles of graduates.

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