Designing knowledge-rich curricula

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Abstract. What role does knowledge have in competency based higher education? Many Dutch Universities of Professional Education are struggling with the implementation of competency-based curricula. In view of current practice, this article distinguishes between two sorts of knowledge: vocation-related knowledge and context-free knowledge. In higher education curricula are developed with the aid of various design-models. The resulting curricula are tied to varying degrees with the field of practice, depending on which model is used. Below three models are typified and compared along four aspects: assignment-driven, vocationally related work processes, integral assessment & testing and knowledge development. Recommendations are then made for ways in which knowledge-rich, competency-based curricula can be developed and improved within the given design models. Keywords here are 'good vocational assignments' and 'accountability of results'.

1 Introduction

In the mid-nineties the very first Dutch competency-based project was started. Ten years later we see that the transition to competency-based education is not always going smoothly: the media are full of items where the fear for the incompatibility of knowledge and competency-based curricula comes forward. This paper describes ways in which knowledge-rich competency-based curricula are developed and can be improved. The point of departure is the set of design-models that are in use in the Netherlands today. The paper finishes with a concluding summary of the relationship between knowledge and competency-based education.

2 Competency-based and knowledge-rich: a paradox?

Competency-based education stands for learning environments that match the future field of practice of the student as much as possible; in the learning environment as well as in the field of practice knowledge, and its application in creating vocational products, is central. Learning is focused on developing competencies in characteristic vocational situations of increasing complexity. Vocational products play an important role here: they make an individual's competency-development visible.

Giving vocational products such a central role is an innovative element in competency-based education. Assessment and testing of developed competencies is based on these (vocational) results and the accounting of their creation. In this way, apart from reproduction, application of knowledge also receives attention: knowledge and its application are prerequisites for arriving at good qualitative results. The results (vocational products and/or services) and accounting for their creation, are a reflection of competent performance.

Creating good qualitative vocational products or results requires knowledge and an ability to apply this knowledge. Both context-free and vocation-related knowledge are needed in creating an accountable vocational product. Both types of knowledge play an important role in competency-based curricula. Where more traditional course-orientated curricula are focused primarily on reproduction of context-free knowledge, competency-based curricula also focus on vocation related knowledge. Making and accounting for a vocational-product (e.g. an auditors' / audit certificate, lessons, research rapport) is cyclical: reflections and feedback on intermediary products (concepts) contribute towards the final product. This 'single loop learning' leads to adjustments during the process which are guided by the requirements that the institute places on the deliverable and the process leading to its creation. The emphasis here is placed on vocationally related knowledge.

When handing in the deliverable a similar process can be organized, by then on a higher level: in 'double loop learning' students compare their products and methods and so come to new insights. At this level of abstraction there is more reference to context-free knowledge.

This 'knowledge development approach' is primarily propagated by 'lectoraten' (Polytechnic research professors) [1].

This leads to the following characteristics of a knowledge-rich competency-based learning-environment:

1. Assignment-driven: there is an (authentic) assignment, taken from the field of practice the student is being trained for.
2. Vocationally related work processes: the learning environment provides, in consultation with the field of practice, requirements (quality criteria) that the deliverable and work process that lead to it must satisfy. Within the learning environment the student can also be asked to provide specific requirements.
3. Integrated assessment and testing: the vocational product (service or deliverable) is the object of the assessment and testing, through which both context-free and vocationally related knowledge are assessed and tested.
4. Knowledge development: the learning environment provides space and time for double loop learning. Newly developed knowledge is recorded.

3 Three design models

Competency-based curricula can be realized in different ways, depending on the culture and innovation drive within the institute. Here three models are described that are used in the Netherlands to design knowledge-rich competency-based learning environments. These are then assessed along the lines of the previous four characteristics.

3.1 Problem Based Learning (PBL)

PBL has been implemented in Dutch Higher Education since the seventies. The distinguishing aspect of PBL was that it offered knowledge related to the field of practice and that students played an active part in finding relevant knowledge.

Certain aspects of PBL pervade much of Dutch higher education, especially there where the focus is on acquiring new knowledge. Characteristic of PBL is [2,3]:

- problems form a major motivation for learning;
- students are provided with a small case, from which they must distil problems and explanations;
- the problems should (just) not match the foreknowledge of the students and be sufficiently complex and structured.

The learning process is split into seven steps; these steps structure the process of the student group.

3.1.1 PBL as knowledge-rich competency-based learning environment

1. Assignment-driven

PBL is often used in higher education as a step-up to competency-based learning. Through PBL the ground work is laid for an essential competency, ‘learning ability’. PBL works well in that context-free knowledge is presented in an integrated way to vocational problems.

2. Vocationally related work processes

We now know that a curriculum based solely on PBL assignments does not properly prepare students for the field of practice. The transfer of knowledge to other problems was too scant. For this reason there have been adjustments to pure PBL the previous years: PBL has been made more complex (more authentic) and aids have been developed to help gauge the complexity and the level of structuralization of a case, which have lead to better matching with the foreknowledge of the students. The focus is still on context-free knowledge, but the application thereof is increased.

3. Integrated assessment

The relationship between the field of practice and context-free knowledge is exposed, although the focus is on context-free knowledge: in some forms of PBL students do make a vocational product / deliverable, but a PBL module is assessed by way of exam and not on the basis of the vocational product or service and the account of its creation.

4. Knowledge development

Until recently PBL was seen primarily as suited to developing context-free knowledge with the help of mainly theoretical vocational assignments.

3.1.2 Conclusions

In our opinion PBL could lead to more knowledge transfer if the student were to work towards a vocational product that was also accounted for and assessed as such. A focus on vocational problems (services) that are not assessed with a knowledge exam but as a product, offers possibilities for competency development and knowledge development and in so doing for innovation in the field of practice.

Many institutes' choice to let go of PBL as the dominant learning style after the first year and focus more on projects fits in well with this view: students are by then more than equipped to formulate their own learning goals, seek out new and relevant information and account for their results.

Writing and working according to a Project Plan and tuning in to the methods in the field of practice initially demand a lot of coaching, but thanks to the PBL ground work these students will probably have less difficulties accounting for their results.

3.2 4 Components of Instructional Design (4C/ID)

The 4C/ID design model originated as a response to PBL. Students work on vocational products as part of the 4C/ID design model and develop competencies in the course of this. Education that is developed through 4C/ID may therefore be viewed as competency-based, more so than in the case of PBL.

The 4C/ID [4] offers a general design strategy for education. This model provides guidelines, suggestions and recommendations for developing an educational programme. The essence of the 4C/ID approach lies in students learning how to work on meaningful, integrational, educational tasks that are derived from professional practice. This professional practice is described in the educational and or vocational profile of the educational programme concerned. By basing the selection of educational tasks on this profile it is possible to secure the level of expertise and competence. The four components of this model are as follows [5]:

- educational tasks represent the rationale for learning. These tasks are authentic and constitute the framework supporting the other components. Educational tasks can vary from complex case studies to a multidisciplinary project which is carried out by a team of students;
- supportive information: this refers to information that may be of assistance when performing educational tasks and is primarily concerned with familiarising oneself with and carrying out non-routine aspects of these tasks;
- "just-in-time" (JIT) information: this is information that is required to familiarise oneself with and carry out educational tasks. It is provided just in time (when needed);
- subsidiary task drills: separately exercising specific subsidiary skills as part of an educational task, so as to automate it in its entirety. This occurs when a teacher is

of the opinion that by working on an educational task alone a student is not acquiring an appropriate routine for work in the field.

3.2.1 4C/ID as knowledge-rich competency-based learning environment

1. Assignment-driven

The 4C/ID model provides a thorough means of analysing educational tasks to their very core and of producing educational segments based on this analysis. Knowledge that is both related to practice and is contextually neutral can play a clearly defined role in this process. The strength of this model lies in the fact that it highlights four important components that need attention when designing an educational environment: educational tasks, supportive and "just-in-time" information, and subsidiary tasks. These components are covered separately when working on complex practical assignments: work on an assignment is structured in advance with the aid of the 4C/ID model. This provides a basis for the student and his teacher (developer and facilitator).

2. Vocationally related work processes

Education is structured in such a manner that students exercise subsidiary skills as part of various courses, before they start work on a major assignment. The rationale for this is that it will enable students to be more capable of locating any information that is provided and to acquire skills before commencing the "real work". As a result the work that is to be done on the relevant vocational product is structured in advance.

3. Integrated assessment

The model focuses on the acquisition of practical expertise. Attention is also devoted to contextually neutral knowledge through courses and lectures. This knowledge is assessed by means of an examination (cf. PBL): a student reveals that he understands a specific model by mentioning its pros and cons. The vocational products are also evaluated, although the achievements of the various student teams are not compared and the students are not (yet) challenged to account for why they have decided on a specific approach or model ("double loop learning").

4. Knowledge development

This type of education involves the development of knowledge, although it occurs within specified "boundaries" ("single loop learning"): the development of a vocational product is structured in advance with the aid of courses and JIT information. Consequently, there is be little variation in approach and products (results) and this means that there will also be a limited opportunity for the development of knowledge and innovation as part of professional practice in the case of this type of education.

3.2.2 Conclusions

4C/ID involves the use of assignments that are recognisable as ones which have been sourced from professional practice. In the case of these assignments an indication is given of the competencies which they demand. An assignment is analysed by educational developers, and courses and subsidiary tasks are devised on

this basis. The students prepare themselves to work on the assignments with the aid of case studies, amongst other things.

An assessment focuses on contextually neutral knowledge. The latter is evaluated by means of an examination. Any vocational product that is created is also assessed: provisionally in formative terms and later on in summative terms. The students are not invited to account for their achievements and no time is scheduled for them to compare their results with each other. A structured operational approach providing uniform support (subsidiary task drills, courses and just-in-time information) produces well-considered vocational products. There is little variation between these products thanks to the sound support. The exploration of new avenues and innovation as part of professional practice only becomes possible, if one abandons pronounced advance structuring.

3.3 HU educational design model

This educational design model was created after years of working with the above-mentioned and other models, the application of various theories [6] and progressive understanding within Hogeschool Utrecht (HU). It is a model which centres around the qualifications of an educational programme, and which sets out the professional expertise and competencies that are required to ensure appropriate performance (the initial level) as part of the occupation in question. This therefore also guarantees the level of competence and expertise.

In addition to these qualifications, a distinction is drawn between the following two types of educational processes (work processes), which are managed independently of each other:

- the development of competencies – the evolution of personal proficiency, such as the ability to learn, analyse, form judgments and so forth. In the course of assessments students are asked to demonstrate their development of such capabilities: they are the subject of the assessment;
- the development of expertise – the body of knowledge of the occupation concerned. Specific vocational products and what is required to create them are at the heart of it. The development of a student's expertise is assessed on the basis of the quality of products (professional and otherwise) which the student creates in the course of his education: these products (professional and otherwise) are the subject of the evaluation. Both contextually neutral and professional expertise play an important role in this respect. This is reflected in the evaluation criteria that are used.

The development of competencies and expertise are inseparably linked to each other, albeit that each exhibits dynamics which are unique to it. In their assessments students are able to reflect or demonstrate the progress they make in acquiring specific competencies with the aid of those of their products (professional and otherwise) which are positively assessed.

A personal development plan represents the guiding element of competency development. A student regularly determines his own profile in relation to predetermined competencies with the aid of self-assessments, peer evaluations and

critical reflection. An assignment (educational or otherwise) constitutes the guiding element for the purposes of developing expertise. The development of this expertise is arranged with the aid of programme modules. The relevant department facilitates the development of expertise by providing guidance in the form of staff-student interaction, a clearly formulated range of modules, unambiguous assessment criteria and the creation of a learning environment (virtual or otherwise).

3.3.1 HU educational design model as knowledge-rich competency-based learning environment

1. Assignment-driven

Assignments represent the guiding element within the HU educational design model. Such an assignment has two sides to it: students are given an assignment to create and account for a vocational product (development of expertise), and to undergo professional development (development of competencies).

2. Vocationally related work processes

This model is currently being employed to design part-time Economics studies. This makes it possible to incorporate the educational process as far as possible within the relevant students' work process. The department stipulates requirements for the field of practice of any student (potential and otherwise) concerned and enters into a contract with the student himself and with his superior (employer). Part-time students are enthusiastic about this type of education. They are able to present problems that they experience in the workplace directly in the course of their studies (learning environment) and vice versa.

3. Integrated assessment

As part of this model a distinction is drawn between two educational processes featuring different dynamics. The assessment that is part of the expertise development process focuses on the quality of the end product which is to be supplied, and how it is accounted for. The assignment is accompanied by criteria (in both concrete terms and at the meta-level) which the end product needs to satisfy. The evaluation of the competency development process is directed towards the student and his development to become a professional. Through assessments a student is able to demonstrate his acquisition of competencies with the aid of positively assessed products or services (achievements), amongst other things.

4. Knowledge development

There is an explicit place for so-called conceptual modules in the analysis of working methods and models. This occurs with the aid of vocational products which the students contribute where possible. The aim is to produce new and/or improved working models. Students have indicated that this approach enables them to apply the knowledge that they acquire in the course of their studies directly in the field.

3.3.2 Conclusions

The HU model is still undergoing development. To date it would appear to offer a great deal of potential for the design of well-developed, knowledge-rich, competency-based education within a part-time educational environment. Close links

with the students' various fields of practice represent a critical success factor in this respect. It is important that the same close links are established with these fields of practice, if this model is to be successfully utilised for full-time education. The potential for achieving this lies in allowing professional practitioners to play various roles within the educational environment, for example, as a client, assessor or educational developer (the contribution of professional standards for the purposes of assessment and evaluation, amongst other things).

4 Conclusion

This paper explains that competency-based education is impossible without the use of knowledge. Within each model knowledge is assigned an explicit role. The assessment of students' achievements or products clarifies that type of knowledge which is accorded the greatest value within the educational environment. In the case of PBL and the 4C/ID a great deal of emphasis is placed on contextually neutral knowledge as part of assessments, whereas both types of knowledge are evaluated in an integrated fashion as part of the HU model. This model offers great potential for the incorporation of both practically oriented and contextually neutral knowledge within the curriculum. An indication has also been given as to how the other two models may be enriched with relatively simple adjustments.

Using the three design methods that have been outlined, it is possible to produce professionals who are not only capable of being deployed immediately but who can also make a contribution to the development of new expertise, thereby introducing innovation into their fields of practice.

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