The Paradox of more Flexibility in Education: Better Control of educational Activities as a Prerequisite for more Flexibility

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Abstract. The paradigm shift towards competency-based education in the Netherlands has a logical counterpart: the need for more flexibility in the curricula. After all, in competency-based education it is recognized that learning not only takes place in designated places (school, university), but may happen every time when the learner is confronted with a challenge. This observation leads to the necessity to incorporate the learning outcomes of formal and informal education in one curriculum. As a result, the educational process becomes more complex and must be better structured to control the individual learning outcomes.
In this paper we discuss this paradox: how more flexibility in the program creates the need for more control in the process. We also discuss what kind of IT-tools are helpful in controlling flexibility in curricula for higher professional education.

Keywords: competency-based education, flexibility, learning activity, higher professional education

1 Introduction

The introduction of competency-based education in the curricula for higher professional education in the Netherlands has resulted in the need for more flexible curricula in order to comply with the individual needs of students with different backgrounds and interests. As the resulting programs become more activity-based instead of content-based, the need arises for new forms of support for the educational process. In this paper we discuss the changes brought forward by this paradigm shift and the consequences for educational tools which, in our opinion (as stated before in [1]), should incorporate the concept of flow and support learning activities, thereby transcending the current data-driven approach and become process-driven instead.

In this paper the changes that the department of Computer Science of the HU University of Applied Sciences[1] has undergone to be better equipped to support a flexible and practically oriented educational process, is examined. A more process-

[1] see http://international.hu.nl for more information on the University

oriented approach, is supported by IT, to improve the manageability of this process is introduced.

1.1 Towards competency-based education

Competency-based education in itself is not a new phenomenon, in the last decades a large amount of research has become available that defines what it is and describes what its goals are (see for example [2], [3], [4] and [5]). A competency is normally associated with a combination of knowledge, skills and attitudes appropriate in a given context. In this paper we use the definition of Dochy and Nickmans [5] who state that "a competency is a personal capability that becomes visible by showing successful behavior in a specific context". Also, a competency can change over time and can be attained by an individual. Furthermore "a competency consists of the following three elements 1) knowledge 2) skills and 3) attitude". In Dochy and Nickmans [5] the difference between domain-general competencies and profession-specific competencies is also highlighted. Universities have always been strong in teaching knowledge, skills and general competencies but in order for students to acquire profession-specific competencies, real life situations and thus involvement of external organizations is preferred.

The introduction of a competency-based curriculum implies the introduction of a new didactical approach as well: in most cases based on a constructivist learning theory (extensively described by Water [6]).

1.2 Flexibility in competency-based curricula

In educational programs, flexibility has various meanings, depending on the context. In this paper we will use the definition of Schellekens [7]: flexibility is "the need to anticipate on differences between individual students in background, study method and speed, preferences etcetera".

Students enrolling a university for a bachelor or master degree have very different backgrounds. While most students come from high school or have vocational training, the number that has prior job experience is increasing. Especially for students with experience in a profession related to the degree course, it has become good practice to determine their competencies in an intake procedure and from there to decide which elements of the course are necessary and where exemptions are possible. In the Netherlands there are several centres which specialize in such procedures, for example the Dutch centre for the accreditation of prior learning (APL)[2].

For students with certified prior learning the curricula of the university should at least have flexible starting points and adaptable routes through their curricula.

A recent development in higher professional education is the introduction of studies which combine learning with work. Part of the study takes place 'on the job': students reflect on projects carried out professionally and in assessments their growth in competencies is measured. As the projects and the resulting experiences of the

[2] see http://www.kenniscentrumevc.nl/apl-english for more information

students vary, this asks for a high degree of flexibility in the curricula and corresponding assessments.

A form of education where flexibility is a necessity is demand-driven education (described by Everwijn [8]). In demand-driven education students compare in assessments their actual competencies with the competencies needed for graduating and from there, formulate learning goals. From these goals they choose courses and projects which may help to reach their goals. Ultimately, no fixed curriculum exists in this form of education; the university offers courses and projects (and of course supervision), while the students choose which courses they will attend to and projects they will participate in, where courses and projects may as well be found outside the university.

From the examples above it is evident that when a curriculum is more competency-based, it is less regulated and it is more difficult for the university to stay in control and decide if and when the students meet the terms of their bachelor or master degree.

In the next parts of this paper we will first provide the context for curriculum development (section 2) and outline the educational process in a competency-based setting (section 3). In section 4 we will develop an architecture for the IT-support of the educational process and finally in section 5 we will discuss the issue of flexibility in the educational program and processes.

2 Curriculum development for higher professional education

As stated above the trend in the Netherlands in professional education is towards more competency-based curricula. In the field of higher professional education in ICT a major player is the HBO-I Foundation[3]. This foundation has set a landmark for bachelor degree curricula in ICT with its publication 'Bachelor of ICT' [9] in which a reference model for ICT-competencies in higher professional education is presented.

2.1 The ICT competencies reference model

The ICT competencies reference model distinguishes five profession-specific ICT-competencies based on the life cycle of ICT-systems and ten domain general competencies based on the Dublin descriptors [10]. The ICT-specific competencies are analysis, advise, design, implementation and maintenance. For the domain general competencies, see figure 1 (A more exhaustive description of all competencies involved can be found in the original publication of the HBO-I foundation, which is available in English [9]).

Recently this description of the domain of ICT has been further developed. The profession-specific competencies as described in the first publication are expanded with five so-called 'architectural layers' describing the user interaction, business processes, software, infrastructure and hardware interfacing aspects. Also three levels of command (basic, simple and complex) have been added, resulting in a 3-dimensional framework of ICT-competencies and additional domain general

[3] see http://www.hbo-i.nl/default.aspx?pageID=24 for more information

competencies. For the domain general competencies no levels of command have been defined up to now.

These additions are described in a second publication of the HBO-I Foundation [11] (not yet available in English) and the resulting model is outlined in figure 1.

With this framework a complete curriculum can be specified by defining for each 'box' which level must be reached by students. The university may then choose in which way the students may reach the desired level: by lectures and practical work, via projects or 'on the job'.

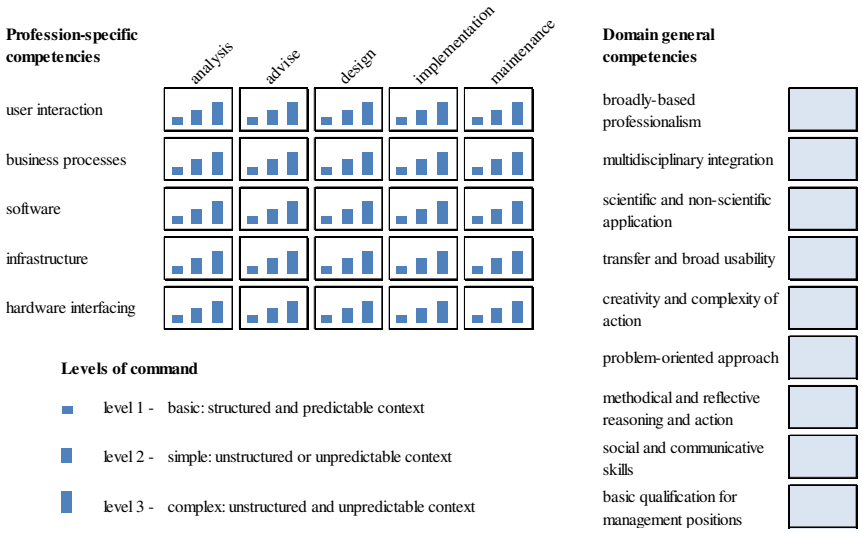

Fig. 1. Extended model for competencies for ICT educational curricula [11]

2.2 ICT curricula at the HU University of Applied Sciences

Last year the HU University of Applied Sciences started to update all (Bachelor) curricula in the Computer Science department so that they will be based on the competencies as described in the reference model described above. We use a constructivist approach so a central element in every curriculum is the creation by students of *professional products*; a professional product being defined as "a typical result for a professional in the line of his work and in accordance with professional standards" (see [12]).

An advice on the use of IT in a branch of the business, a software program (including design documentation), a portal for a department, the security of information during a certain period, all these are examples of professional products.

In redefining the curricula the following steps as outlined by Schmeltz [13], are taken:

1. Depending on the profession at which the curriculum is aimed, the desired level in each of the various 'boxes' of the reference model is decided upon in consultation

with the ICT-industry. The resulting description defines the competency-level of the overall program.
2. For each term (in Utrecht a typical term takes three months), one or more professional products which the students are expected to create in that term, are determined together with the competencies needed to create the products, thereby using the framework (including domain general competencies). The set of competencies per term must of course cover the competencies of the overall program.
3. Necessary knowledge elements and practical skills are added as courses to complete the terms.

In an assessment at the end of every term, students have to show that they have mastered the various competencies at the prescribed level.

The resulting curricula have quite a lot of possibilities for flexibility. Current practice is that the first professional products are made from case-descriptions, but starting in the second year these cases are replaced by real projects from real companies who in some cases also play a role in the supervision of the projects. In the third and fourth year of their study, students have the opportunity to follow their own interest and choose the subjects they prefer (restricted of course by the degree course they are enrolled in because after all, the students do have to show progress in the competencies for the jobs where the curriculum is directed at).

In a later phase when there is more experience with this model, more flexibility can easily be added (especially for students who are already working in the ICT domain); the model itself offers possibilities enough!

3 The educational process

In the preceding paragraphs the focus has been on the curricula and the educational programs. A program is the execution of a curriculum and is, in a traditional environment, more or less the same for all students. The educational process in such an environment consists of deciding which program a student should follow and marking the results.

Typically the educational process is supported by tools which offer the (often combined) functionality of a catalog of courses and registering marks for individual students so progress (in terms of credit points) can be measured.

In a competency-based environment the educational focus shifts as we have seen towards activities performed by students. These activities may vary quite a lot between students. To be able to follow the progress of an individual student (and not only the result of his activities), supporting tools should be able to support workflow functionality. Let us illustrate this with an example we described in an earlier paper [1]:

In a term on e-business the professional product is an e-business application where, in accordance with good software engineering practice, students are asked to model the business process, model the application, build the software and test the application. Depending on the organization, the nature of the business processes

involved and the background of the various students, different approaches are possible. So students start with a plan explaining what is to be done, in which way and when. The impossibility to implement this plan in the learning environment of the course is criticized in the paper and the need for more flexible tools expressed.

In the example the support is defined in terms of an electronic learning environment. On a higher level an (individual) program can be seen as an instance of the curriculum and consists of activities and courses which both may lead to results – results being entries in the individual portfolio and/or as credit points (see figure 2).

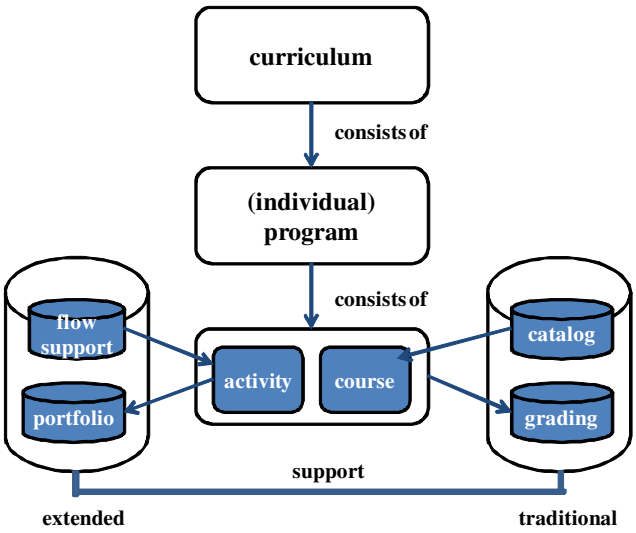

Fig. 2. Extended support for educational activities

So in a competency-based setting the need for more and different support originates from the introduction of learning activities in the educational programs.

So far we described the changing educational environment in the Netherlands which caused the need for more flexibility in the curricula. We recognized that learning no longer takes place only in designated places like a university but is spread out over many activities at many different locations both national and international. This causes the need to incorporate the learning outcomes of formal and informal education in one curriculum. As a result the educational process becomes more complex and must be better structured and supported in novel ways by information systems to enable management and control of the individual learning outcomes. While in this way the educational programs become more flexible, it also means that the supporting processes must be defined more strictly.

In the department of Computer Science of the HU University of Applied Sciences we are currently redefining our educational and supporting processes, based on the notions as described in this paper and the continuous improvement cycle (PDCA) as introduced by Deming [14].

4. IT tools for the educational process

From the previous sections it becomes clear that IT-systems supporting both the educational and the supporting processes should transcend the current data driven approach. A new generation of tools should become process-driven, based upon the educational processes which are becoming less structured and contain ever more ad-hoc activities that are a natural part of a competency-based curriculum.

In a competency-based educational environment, ideally a workflow should be instantiated when a student enrolls for a degree course. This workflow can be (sparsely) populated with the milestones corresponding with the competencies that are part of a curriculum. While the students follow their programs, the university (or the students themselves) can add activities, courses and further milestones to the individual workflows. For the individual student the same tool may show itself as an electronic learning environment (ELO) in predefined courses, as a project (planning) tool while working on a professional product, as a (social) community while engaged in activities with fellow students/co-workers or as their portfolio, documenting their professional growth. Simultaneously such a system should be able to support the administrative and logistical processes that support the students' progress during their education.

4.1 A basic architecture for IT-support of the educational process

To select, implement and align the information systems to the changing educational setting we use concepts from the domain of IT Architecture to provide a blueprint for IT projects in the university. In the Open Group Architecture Framework (TOGAF) the Open Group [15] states that it is not possible to design a good organizational structure with supporting information systems without using architecture. Lankhorst et al. [16] describe how to develop enterprise architectures in practice.

For the activity-based educational process we developed a model as shown in figure 2. By adding support for coaching, we come to a basic architecture for the support of the educational process as outlined in figure 3.

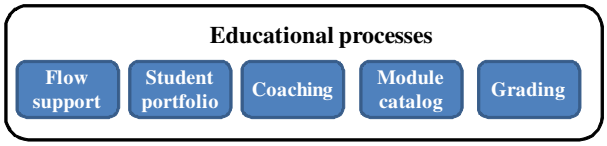

Fig 3. Basic architecture for the support of the educational process

4.2 An extended architecture for IT-support of the educational process

In practice a university has several more areas where IT-support is needed in support of the organizational processes, such as the logistic (planning and control) and the administrative (registration) processes. Therefore we extend our basic architecture with these processes (shown in figure 4).

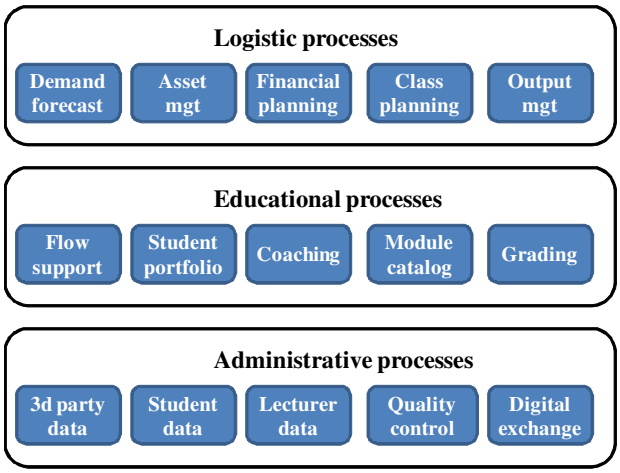

Fig 4. Extended architecture for the support of the educational process

The proposed architecture has three main areas of functionality: 1) logistics 2) educational and 3) administrative. Currently most universities will already have applications in place to support most of the activities and processes in these areas but typically these are not integrated. This can cause many problems ranging from a mismatch in lecturer skills compared to the competencies and modules that need to be taught to planning and production not being aligned (e.g. not enough classrooms or lecturers available when needed) or students attending classes which they are not allowed to.

5 Conclusion

As shown in the previous sections, education is changing from knowledge- to competency-based. A consequence of this change is that curricula have to become more oriented towards activities. More specific: towards real and professional activities which are related to professional products whether they are situated in a educational or real life context.

For the educational process this means that students should be given authentic questions related to genuine real life settings (which may be simulated for first year students). The best way to provide such a setting is by confronting students with genuine projects from existing companies which act as customer, thereby creating a real context.

In curricula built around competences and professional products, flexibility is a natural outcome as the individual student programs may vary as they are centered on 'need to learn' instead of 'need to know'.

Building competency-based curricula has one big pitfall though. Professionals use – often implicit – quite a lot of theoretical knowledge. This knowledge must be made explicit in a learning environment to guarantee that students reach an academic level. Therefore a curriculum consists not only of a set of professional products, but includes a 'knowledge base' that students have to learn as well.

In order to monitor student progression, new forms of support which implement the activity-based paradigm instead of the traditional data-driven approach are necessary. A functional architecture for such a system is presented in this paper. Based on this architecture, universities may review their existing applications and information systems to determine which areas are sufficiently supported (with systems that can be reused and integrated in the proposed architecture) and where there are deficiencies. We expect that this effort will help to professionalize the internal processes and organizational capabilities in such a way that cooperation with external partners will become easier, thereby giving more flexibility to students.

A complicating factor in competence-based curricula is that students are ever more taking up learning activities outside the university. Although the university encourages students to do internships and participate in external research or consultancy projects as part of their education, this increases the complexity of coordinating a student's educational process. For example examination and assessments must not only be aligned with internal courses but also to external activities. Current organizational processes and IT systems in many universities are lacking support for such a new way of working. Here we see an example of our starting hypothesis: more flexibility in the student programs creates the need for more control in the educational process.

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