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Siegfried Rouvrais, Vanea Chiprianov

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MODELING AND ARCHITECTING EDUCATIONAL FRAMEWORKS

Siegfried Rouvrais[1] and Vanea Chiprianov[1,2]

[1] Telecom Bretagne, Université européenne de Bretagne, Brest, France
[2] UMR CNRS 3192 Lab-STICC

ABSTRACT

Nowadays, there are several program criteria that are proposed for accreditation. However, up to represent various accreditation bodies' requirements, diversity of disciplines, and specific national contexts, no global and unified framework for higher education has emerged. As such, the ability of educational organizations to work together is often hard to ensure. Following constructive alignment principles, an educational program relies on three main pillars: (i) an intended curriculum, (ii) a taught curriculum, and (iii) a validated learned curriculum. At the core of program descriptions, those three views share concepts, such as learning outcomes. To enable interoperability among existing programs and frameworks, and sustain flexibility and evolution of standards, it is relevant to clarify common core concepts belonging to various frameworks. A system modeling approach is obvious for meeting such interoperability challenges, since it makes it possible to meaningfully, unambiguously, and accurately specify concepts, relations, and viewpoints among stakeholders.

The CDIO Initiative celebrates its 10th anniversary by proposing today a mature integrated framework for engineering programs. Structured in twelve standards, it permits to create, to reform, or to continuously improve engineering educational programs. It encourages introducing appropriate pedagogical methods and also addresses student workspaces and staff workforce. Based on the CDIO standards as a proof of concept, this paper proposes to model three views based on structural diagrams. Significant relations between educational concepts are then defined. Furthermore, getting its inspiration from an architectural approach, this paper significantly contributes to lay the foundations of an architectural meta-model for describing complex educational systems, which will contribute to tackling interoperability and flexibility issues.

KEYWORDS

Educational frameworks, constructive alignment, sustaining curriculum reform, facilitating change in engineering education, application of CDIO to a wide range of disciplines.

INTRODUCTION

Transformation of educational programs plays a recurrent and key role in the future of an institution (e.g. school, university). It impacts its operating modes, its quality and its future performance. The management of educational systems (e.g. programs, workforce, workspaces) is thus of strategic importance. As such, during the last decade, various initiatives on quality management models and educational frameworks have spawned, proposing a class of standards that allows educators and program leaders to evaluate and improve their various curricula, services and resources. However, their increasing complexity requires different types of expertise from various stakeholders (e.g. program designers, managers). Moreover, complex processes are involved in these initiatives, some of which are not always well described and controlled.

To prepare the next generation of engineers, the 12 standards of the CDIO educational framework offer many keys for reforming or continuously improve engineering programs. Representing much more than a simple syllabus organizing learning outcomes, they form a multidimensional educational constellation addressing several stakeholders' issues (e.g. hints on workspaces, curriculum integration, learning styles, faculty development, assessment and evaluation). Nevertheless, to maintain the pace with the evolution of societal and educational environments and missions, the CDIO framework should remain a dynamic tool: Firstly, the framework itself may need to be updated (e.g. see recent changes of standard #2 syllabus relating to sustainability, leadership and entrepreneurship issues [1], interrogations on a 13^{th} standard, etc); Secondly, educational institutions must often adapt the CDIO framework to their own reality dependant on quality requirements (e.g. criteria defined by professional or governmental accreditation boards, specific quality management models); Lastly, business constraints (e.g. costs) and incitements to collaborate more and more formally with potential partners (e.g. for deeper visibility, ratings and rankings, student exchanges, etc.), sometimes drive educational institutions to juggle with various educational systems, or even frameworks [2], at the risk of creating inconsistency and interoperability problems.

Following constructive alignment principles [3], based on objectives, teaching and assessment viewpoints, this paper identifies key concepts for modeling educational systems. By proposing three sound models, it contributes structuring unambiguously relations among those concepts. Derived from an analysis of the CDIO standards from conceptual and structural perspectives, and inspired by best practices of modeling [4], it reveals accurate semantic relations among these three models. Based on multiple views, it thus permits to clarify, at an abstract level, the now complex CDIO instance. Furthermore, getting its inspiration from a standardised complex system architecting approach, this paper highly contributes to lay the foundations of an architectural meta-model (i.e. highlighting concepts and properties of the domain models) for educational systems and which could address, more holistically, interoperability and flexibility among educational frameworks.

This paper is structured as follows. After the introduction, some existing notations for educational modeling are surveyed. In the next section, based on the CDIO standards as a case study, three conceptual and structural diagrams for constructive alignment are proposed. They correspond to educational program pillars: (i) an intended declared curriculum model, (ii) an enacted taught curriculum model, and (iii) a validated learned curriculum model. It is herein argued that several of the CDIO standards could be regarded as resources, properties or constraints in such system models. Relations between these models are then derived at the end of this section. Following section examines the benefits of educational system modeling for various stakeholders, and presents the requirements for constructing viewpoints that cover dedicated concerns. Before concluding and providing some perspectives, the last section reviews some quality management models in education so as to pave the way for future work on behavioural educational modeling.

MODELING EDUCATIONAL FRAMEWORKS

As the complexity and size of educational systems increase, accuracy emerges as a problem. Some equivocal terms are used, sometimes without common understanding. Thus, it is a major concern to describe and share unambiguously common concepts among the various stakeholders involved in a program design or transformation. In such a context, modeling approaches permit to represent, visualize, and document the artefacts of a system. In fact, models [4] permit to unambiguously and consistently describe concepts and their relations. Among other benefits, by minimizing ambiguities and introducing some formality, they favor better understanding, coherency, alignment, analysis and (re)usability of informal principles and recommendations.

Educational Modeling Languages

Several notations or languages exist for educational modeling. Martinez *et al.* classifies education modelling languages in three categories [5]:

1. Content Structuring Languages, which allow designers to arrange the learning resources in sequences, always taking into account the learner's needs and performance in order to improve the learning experience;
2. Activity Languages, which focus on the activities in general during the learning process;
3. Evaluation Languages, which allow designers to describe the stages of the learning process, in which problem-solving or question-answering are involved, in an abstract way.

In the last decade, Rawlings *et al.* define the Educational Modelling Language (EML) as: "a semantic information model and binding, describing the content and process within a 'unit of learning' from a pedagogical perspective in order to support reuse and interoperability" [6]. In this context, EML is used to describe units of learning, including the operational flow of learning activities. Directly associated with learning management systems and used for creating online learning activities, such modeling languages are far from being manageable by non expert stakeholders involved in a holistic educational framework, as they are mainly addressing low level metadata in files for interpretation and processing by software engines. Note that some more fined grained notations have been introduced for modeling educational units or activities [7], but they are outside the scope of the proposals of this paper.

The Unified Modeling Language

Initiated for software engineering purposes, the Unified Modeling Language (UML) [8] is the accepted standard for specifying and documenting software systems. Due to its expressive strength and relative simplicity, it is more and more used to create visual models other types of systems (e.g. in engineering, information or enterprise systems, or even business and finance domains). As such, it is also a very good candidate for educational system and framework modeling. Several notations are proposed in the arena of UML to create diagrams, in two distinct views.

UML Structural View

Several structural modeling diagrams are used for defining the building elements of a model, but also for describing their relationships and dependencies. Figure 1 sketches the basic notations proposed in UML class diagrams which will be used in the various proposals of this paper:

1. The first *Association* relation, represented by a link, means there is a connection between two concepts. In the example (cf. the top of the figure), there is one *AConcept* which is associated with one *AnotherConcept*. An annotation or verb can be attached to the link. The cardinality of the association is here of type 1-1;

2. Associations can support multiplicities, on one end or on each of the two ends of a link. For example, the second relation of the figure specifies that *ContainingConcept* is associated with zero or more *ContainedConcepts* (cf. '*' multiplicity). Each *ContainedConcepts* has to be of the same type, but has a different instance. By default, if there is no multiplicity specified on a link, it is considered 1 (as in the first relation); Multiplicities can also be of type 1..*, if at least one *ContainedConcept* is required;
3. The third and last relation in the figure, *Inheritance*, means that *SubConcept* has all the properties of *SuperConcept*. *SubConcept* can have new properties, which *SuperConcept* did not have, and can redefine properties inherited from *SuperConcept*. Note that the direction of the arrowed link is of importance.

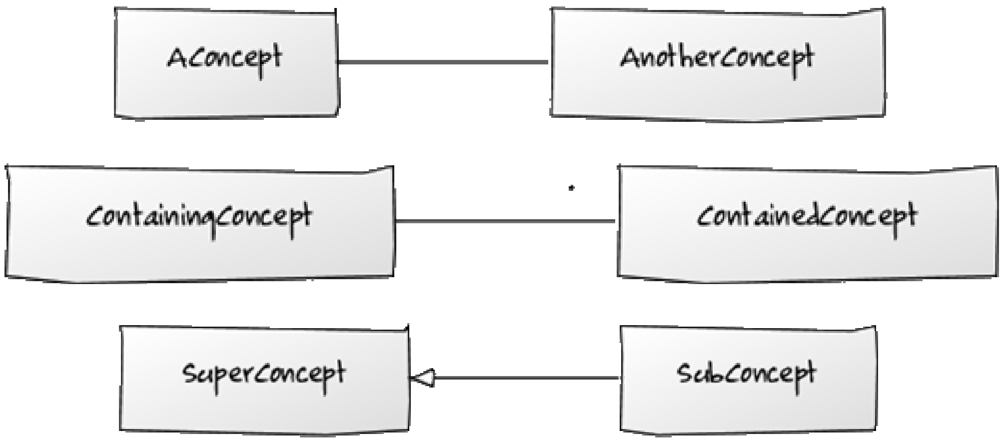

Figure 1. Basic relations between concepts for structural modeling in UML.

Behavioral View

Behavioral diagrams make it possible to capture the varieties of interactions among elements, their inputs or outputs, and their states and dynamicity over time. To model this, among others, UML proposes use case diagrams and communication diagrams. Temporal models could have been introduced as well (e.g. UML activity diagrams or by using other dedicated business process modeling notations, like BPMN [9]). In fact, educational processes, e.g. like student recruitment, pedagogical development and deployment, course or project unit design and implementation [10], require specific behavioural notations. However, only structural views will be considered in the rest of this paper.

STRUCTURALLY MODELING AN EDUCATIONAL FRAMEWORK: CDIO CASE STUDY

Constructive alignment [3] clarifies the design of curricula and sheds light on the association and alignment among intended learning outcomes, taught curriculum (including learning activities) and assessment. Harden [11] also clarifies that a curriculum is not limited to course contents. It can be decomposed in views using (i) an intended declared curriculum model, (ii) an enacted taught curriculum model, and (iii) a validated learned curriculum model. These three models share common concepts, learning outcomes is one which is addressed by all these three perspectives.

When numerous concepts are interconnected, e.g. from structural or behavioral perspectives, the notion of integrated curriculum [12] facilitates coherency among many sub-elements. As such, the next subsections propose structural diagrams for three CDIO standards to further highlight conceptual relations between these models from a more global point of view.

Modeling CDIO Standard #2: "Syllabus Outcomes"

The intended curriculum (or declared curriculum) most often addresses concepts including learning outcomes, knowledge and skills (sometimes attributes). As in the CDIO Standard #2, these concepts are rarely left alone; they are most often associated with each other. The concepts and associations can be represented in a diagram as abstractly proposed in figure 2, where a *Syllabus* is composed from 0 or more *Learning Outcomes* (cf. '*' multiplicity between the two concepts). There may be *Optional Outcomes*, described through the inheritance relation between *Optional* and *Learning Outcome* concepts. A learning outcome is associated with 0 or more *Activity Domains*, *Core Knowledge* and *Skills*. For the CDIO syllabus, there are several types of *Activity Domains*, modeled through the inheritance relation with *Operating*, *Implementing*, *Designing*, and *Conceiving*. Skills as well, can be *Interpersonal* or *Personal,* by inheritance. A program, conforming to such a model, could be checked for completeness, e.g. with the CDIO syllabus or EQF/EUR-ACE [13].

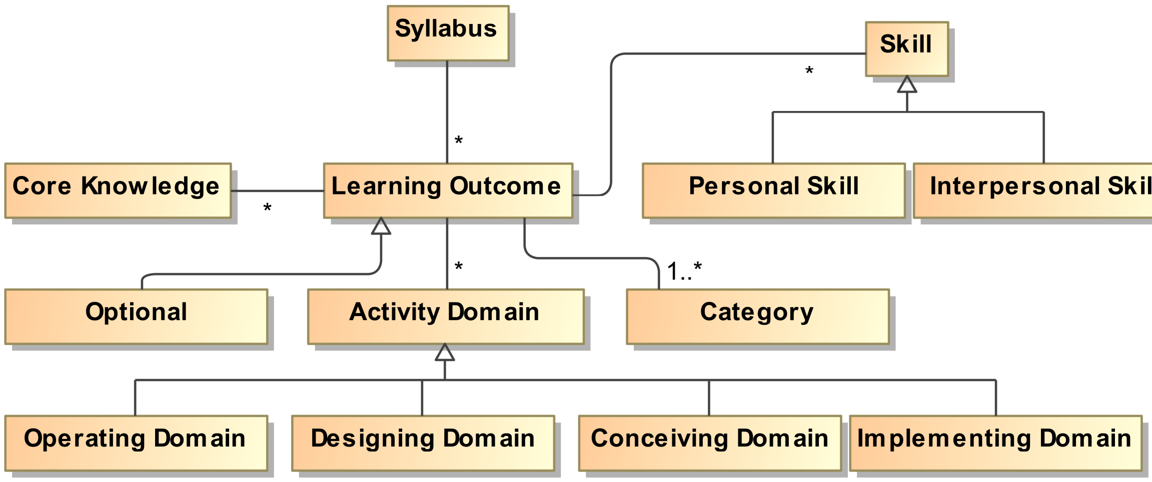

Figure 2. Intended curriculum diagram.

Note that in the proposed model of figure 2, categories could have been associated with learning outcomes, for example, Bloom or Anderson & Krathwohl cognitive and knowledge dimensions, or even EQF descriptors.

Modeling CDIO Standard #3: "Integrated Curriculum"

The taught curriculum (or enacted *Program*) supports the declaration of *Courses* and associated *Activities* as defined in a program booklet. By relying on the CDIO Standard #3, where a *Program* contains several courses, its concepts and associations can be represented in a diagram as proposed in figure 3. By inheritance, there are different types of courses, Core, *Introductory*, *Major*, *Minor*, or *Elective*. A *Course*, whatever its type, could contain several *Activities*, which, by inheritance, can be of type *Tutorial*, *Laboratory*, *Project*, *Lecture*, *Seminar,* etc. More structural description details can be provided, e.g. by inheritance, a *Project* concept could be refined with e.g. *Introductory Project* or *Capstone Project*. An *Activity* has several *Resources* allocated, which can simply be of type *Room* (e.g. workspaces), and/or *Teacher*, etc. If necessary, *Activities* can be associated with *Learning Styles* (e.g. instructive, problem-based learning, etc.). *Extracurricular Activities* and *Internships* are also possible part of a *Program.*

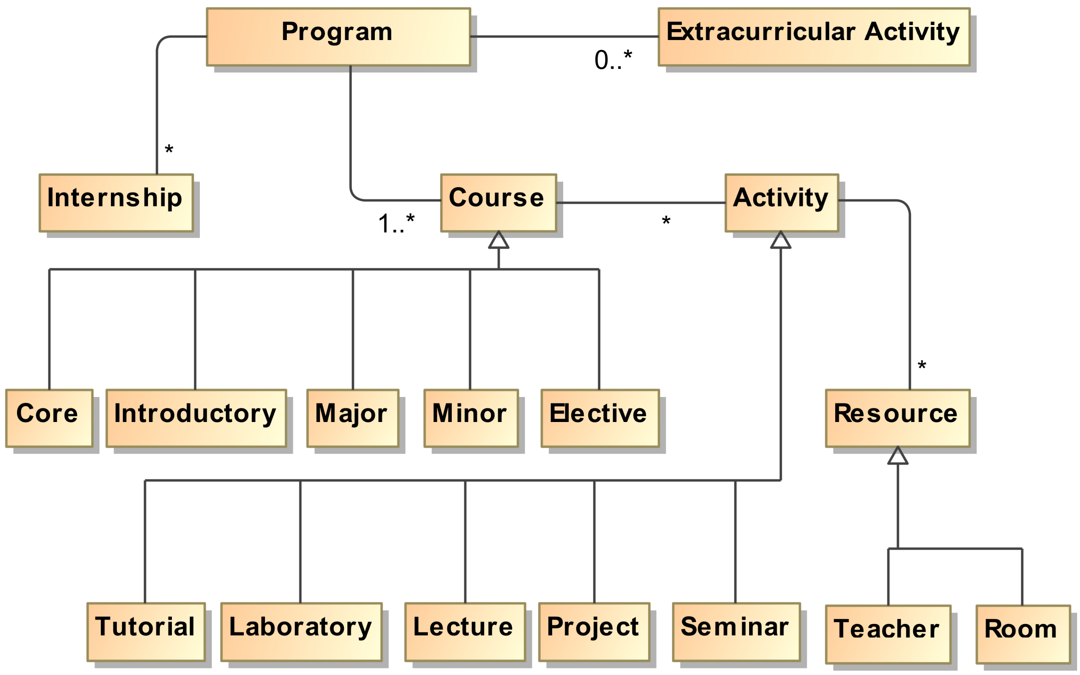

Figure 3. Taught curriculum diagram.

Modeling CDIO Standard #11: "Skills Assessment"

The validated curriculum (or learned curriculum) clarifies the assessment activities, which could be of various types [14]. Following some of the recommendations of CDIO Standard #11, the concepts and associations can be represented in a diagram as proposed in figure 4. Types of *Assessment*, which can be *Exam*, *Oral Presentation*, *Report*, *Portofolio*, *Interview* or *Moral* are described. An *Assessment* may have several *Forms*, which can be *Formative* or *Sumative/Informative*. *Assessments* are classically associated with a *Proficiency Level*.

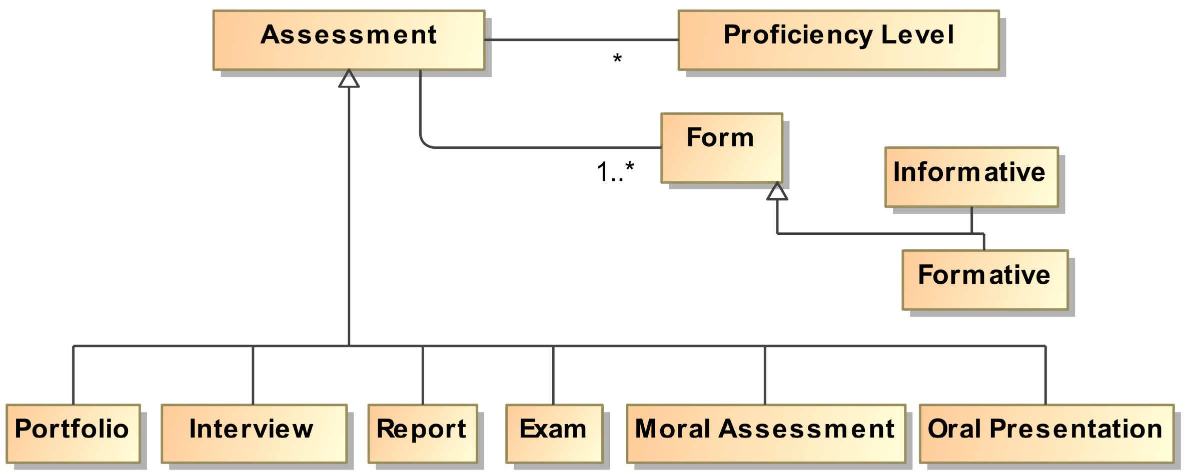

Figure 4. Validated curriculum diagram.

What about the Other CDIO Standards?

We propose three diagrams as a graphical representation of curriculum's models. However, a model also contains elements of documentation that clarify the concepts and diagrams (e.g. properties, design rationale). We have seen that a curriculum can be described through three views following a structural approach. In integrated educational frameworks, several other guidelines are also provided. In our opinion, the other CDIO standards could be taken into account as follows:

1. Standards #4 “Introduction to Engineering”, #5 “Design-Build Experiences”, and #7 “Integrated Learning Experiences” are mainly constraints or properties (as good practices to follow) for the taught curriculum model;
2. Standard #8 “Active Learning”, as a specific pedagogical style, is to be associated with activities of the taught model;
3. Standard #6 “CDIO Workspaces” is also a set of properties/constraints for the enacted taught curriculum, mostly associated with resources (cf. *Rooms*);
4. Standards #9 “Enhancement of Faculty CDIO Skills” and #10 “Enhancement of Faculty Teaching Skills” are specific, since they are not directly associated with the curriculum. However, as part of an other view, they share concepts like the syllabus and participate e.g. in the *Teacher* concept as resources in the enacted taught curriculum;
5. Standard #12 “CDIO Program Evaluation” is quite orthogonal with the other standards, even if it could be integrated as a learning activity. Its behavioral models (e.g. process) are of importance for continuous improvement, but are not addressed so far in this paper;
6. CDIO standard #1 “CDIO as a context” can be seen as principles to follow, a mission statement. It will be discussed in the following section on architecting educational frameworks.

Relations among Models

Proficiency Levels and Categories

The connection between the first intended (cf. figure 2) and the third validated (cf. figure 4) curriculum models consists in the fact that the *Assessment* concept determines the *Proficiency Level* which a student has achieved for a *Learning Objective*. To measure this level, predefined standard scales are needed, e.g.:

- The European Qualification Framework (EQF) introduces eight reference levels [13]. It covers the full range of qualifications generally acquired, including vocational/academic education and training, from basic levels (e.g. Level 1 for school leaving certificates) to advanced levels (e.g. Level 8, for Doctoral degrees). Here also, each level is described in terms of learning outcomes.
- Bloom categories, or dimensions, could be addressed as well if present in the intended model as discussed earlier.

With such categories specified, model transformations could be provided to switch from one category to another [2].

This relation is depicted at the bottom left of figure 5 (in red), with an ‘1..*’ multiplicity on both end. The *Assessment* concept of the third validated model can be associated by inheritance with the *Activity* concept of the second taught model, since it is a part of a course (cf. bottom right in the figure).

Curriculum Maps

Learning outcomes of the intended model are also associated with activities of the taught model. As two dimensional matrixes, simple curriculum maps are used as a visual representation to associate intended and declared curriculum [11]. Classically, course codes are listed in a first -possibly temporally ordered- axis, and higher level learning outcomes are listed as a second axis -also possibly ordered. Proficiency or degree level expectations can be introduced on intersections when a course addresses a specific learning outcome. Curriculum mapping facilitates transparency among stakeholders and favour completeness and coherency issues of learning outcomes throughout the declared curriculum.

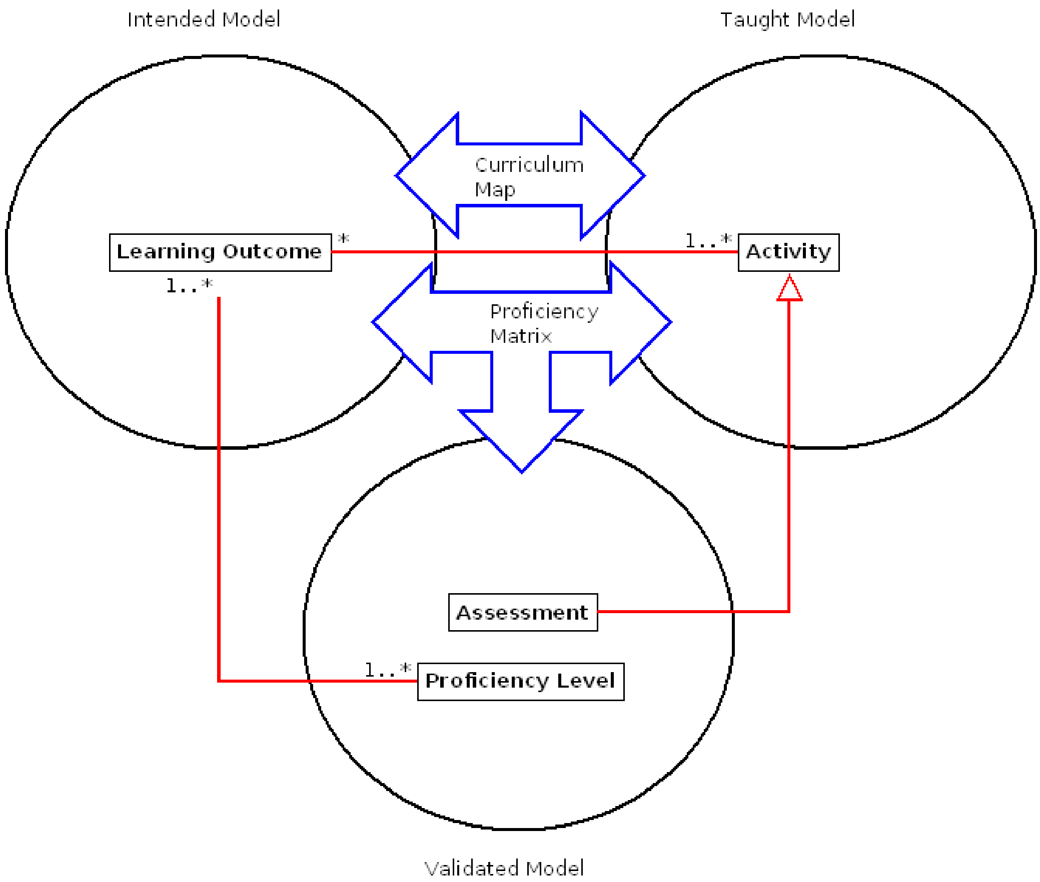

Figure 5. Concept associations among models.

Proficiency Matrixes

By associating curriculum mapping and *Assessment* concept, thanks to the relations among the various concepts, it is possible to establish a three dimensional matrix including the effective proficiencies of learners. Figure 6 presents such a matrix, with courses and professional experiences from the second taught model in rows and classified learning outcomes from the first intended model in columns. A sub-matrix is zoomed in the left upper part of the figure, including declared proficiency levels from the validated model (using a five-color scale). As such, the three models have permitted to transitively associate concepts which could form the cornerstone of an integrated curriculum.

ARCHITECTING EDUCATIONAL FRAMEWORKS: STAKEHOLDERS VIEWPOINTS

To manage the various proposed concepts and models in a unified manner, following an architectural modeling approach is the key. As proposed in the IEEE 1471 recommended practice [15], a system is best documented via its architecture. Generally speaking, a system could be an enterprise, a service or product, a system of systems, etc. From a system perspective, an educational system conforms to a meta-model, highlighting concepts and properties of the domain models. It exists within an environment which influences it, and fulfills one or several missions (e.g., as found in the CDIO standard #1).

Figure 6. Learner proficiency matrix example
-including 64-experiences/courses (rows) x 113-capacity (columns)-
with categories and blocks (developed by a candidate for graduation), from [16].

A well organized educational framework prompts architecture. The *Architecture* of an *Educational System* (concept in red in top left of the figure 7) is described by a unique - ideally unambiguous- *Architectural Description* (seen as the concrete description). Above all, the architectural description is organized by several *Views* (conforming to *Viewpoints*). To participate in one or several view, we propose to describe an educational system with an aggregation of the three presented curriculum models (concepts in red in the down right of the figure). These three models enable constructing the overall educational system description, which should conform to properties and constraints (e.g. learning styles, introductory elements or advanced level experiences, workspaces).

Several concepts, such as *Stakeholders* and *Concerns* are also proposed. A stakeholder has interests in one or several concerns. Taking inspiration from such an architectural approach, by investigating various *Models* and stakeholders' *Views* for engineering complex educational systems, a set of reference *Viewpoints* would be largely beneficial, particularly because of the large number of stakeholders involved, e.g.:

- students,
- faculty and program managers,
- employers of graduates,
- educators, instructors and external teachers,
- educational researchers,
- governmental and industrial accreditation boards, and industry representatives,
- internal quality assurance managers,
- alumni, parents or K12 secondary students,
- partners, potential investors, sponsors, etc.

Each *Viewpoint* is used to cover several *Concerns*. As an example, a program or course datasheet (and the same is true for as for curriculum maps, proficiency matrixes) has multiple roles, sometimes contradictory. Indeed, such datasheet is a shared tool between the education services and the program or course managers, between teachers and students, between the institution and the public in search of information details on contents, but also between the school/university and the accreditation bodies. All these stakeholders have various concerns and do not necessarily have to be aware of all the subconcepts, constraints and details in a unique model.

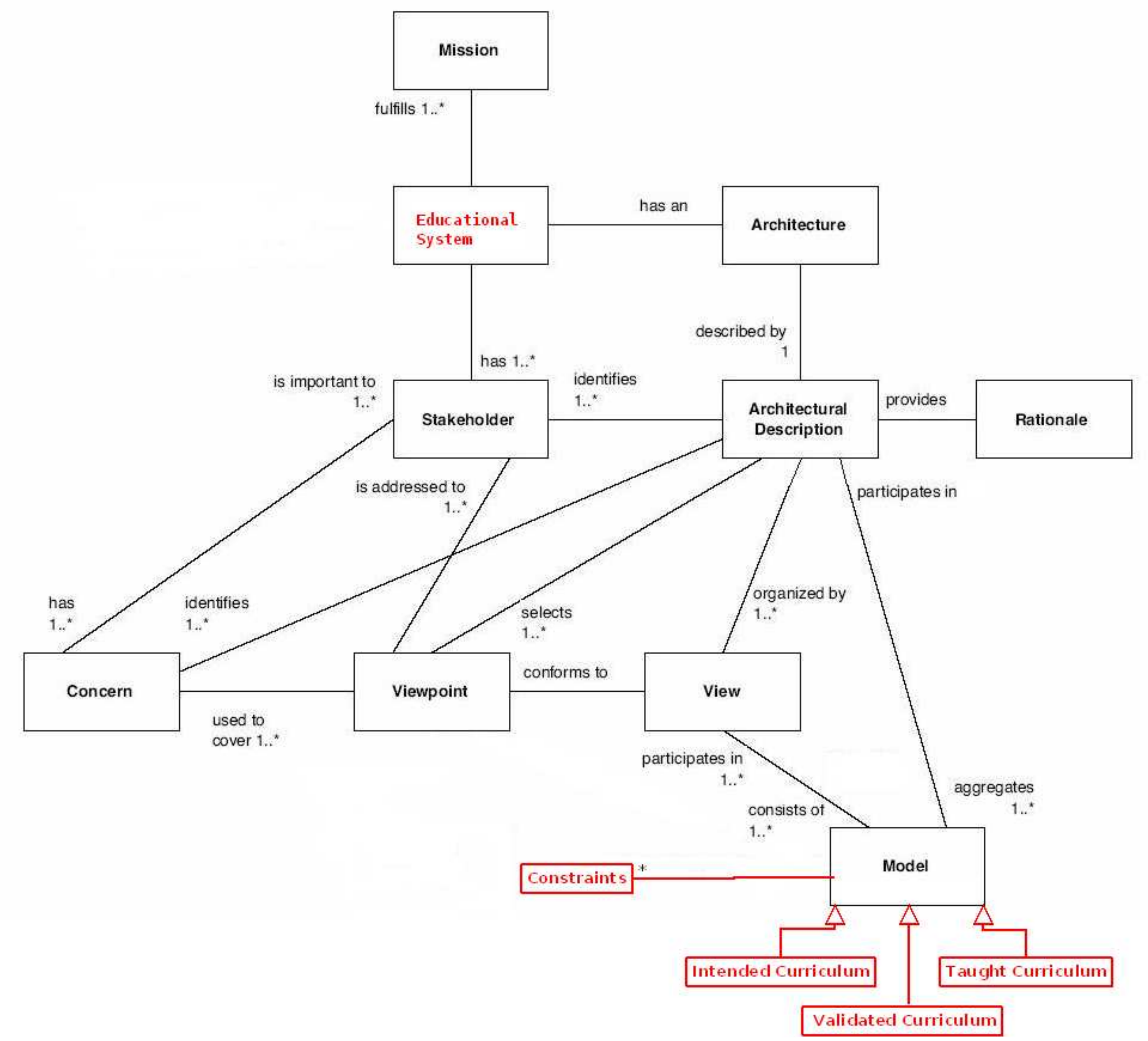

Figure 7. IEEE-1471 system overview meta-model,
slightly revamped for the educational context.

QUALITY MANAGEMENT IN EDUCATION

Models are also addressed in quality assurance. From a business process management point of view, even if the mission of education is not only service-based but also information-based (e.g., as knowledge), an educational institution principally provides educational programs and services. Through the definition, analysis and optimization of their processes, engineering educational institutions are nowadays more and more requested, by professional societies or governmental regulations, to meet quality standards [17]. The management style of higher education has been discussed for several years, and is still controversial [18]. It is often said that in order to manage a transformation project and to continuously meet quality requirements, two distinct disciplines are to be mastered: engineering (e.g., design, conceive, implement) and management (e.g., plan, decide, communicate, control). Some higher education institutions are turning to total quality management models, sometimes following corporate style management, so as to support deep improvement opportunities.

Corporate Style Quality Management in Education and Performance

In broad lines, if seen as an enterprise, an institution has one or several missions defined, inhabits an environment, and possibly has to conform to various constraints. It will be seen as a provider of value to its clients/customers (e.g. students, employers, future entrants). With this perspective, an institution principally proposes as product an educational program with associated services. Among other stakeholders, the student is finally the main customer, with requirements and expectations.

Several models of quality management in education have appeared pursuant to such a corporate style [19]. For example, the Malcom Baldrige Performance Excellence Program, managed by NIST, proposes education criteria for performance excellence [20]. Customer (e.g. students, stakeholders) and workforce focus are addressed in categories of the corresponding quality framework pursuant to a system perspective. Other categories are leadership, strategic planning, knowledge management, operation focus and results. As another example, the European Foundation for Quality management (EFQM) Excellence Model [21] has followed a business model. Several concepts underpin EQFM, i.e. result orientation, customer focus, leadership, management by processes and facts, people and partnership development, continuous learning, and corporate social responsibility. This model also focuses on what an organization could do to produce a better service or product for its customers, or service users, as well as stakeholders. The model is based on five key enablers of improvement: leadership, people, policy and strategy, partnership and resources, and processes.

The various propositions and results of this paper are more formal and structured than the two above-mentioned and explicit more precisely the alignment among views. However, for the moment, they are limited to structural models and do not address business processes and planning.

Business Process Vision

Following a business process management vision, an educational institution executes declared processes, using as inputs external and internal values (e.g. external from partners, suppliers, internal from staff and workforce) and consuming/using resources. To improve quality and remain valuable, an institution should understand its customer needs and design processes so as to meet their requirements. It is even more the case when customers, such as students, participate as actors in several of those activities, in interaction with resources. However, to explicit business and operational processes among stakeholders, and minimize ambiguities, behavioural specification languages are very welcome. To this effect, and to favor continuous improvement, educational institutions could rely on an integrated approach aiming at modeling their processes, collaborations, or their infrastructures (e.g. physical and human resources, information systems [22], etc.), as well as some elements of their strategy and motivation. Being complex, and apart from the management activities, these engineering activities are also classically the responsibility of architects (e.g. designing processes and critical infrastructures for an institution’s current and future operations), representing and documenting the whole educational system with models.

CDIO Program Assessment Approach Encouraging Well Managed Processes

Educational frameworks and requirements defined by accreditation bodies (e.g. ABET, EQF/EUR-ACE, Engineers Australia) tend also to address in their standards processes for better quality management. In the CDIO initiative, initially one generic rubric was used for program self-assessment (with a hierarchical scoring, scale from 0 to 5) to check conformity with the CDIO principles. In 2010, rubrics were specialized for each of the twelve standards. They all use a common scale for the ratings. The Standard # 12, on program evaluation, is CDIO's cornerstone of continuous improvement. As such, several methods could cohabit with the ones of accreditation bodies, and the CDIO self-assessment method of compliance is a complement to them. For systematic and continuous improvement at CDIO-levels 4 and 5, well managed processes are a key element. Nevertheless, at the maximum level 5, standards 2, 3, and 11 include evaluation by external groups. To ensure a regular and systematic review, as well as future recommendations for continuous improvement, models - including structural and process models- are here also a key issue for the various stakeholder groups with respective viewpoints.

CONCLUSION AND PERSPECTIVES

Educational frameworks are defined with varying degrees of rigor, and can thus lead to ambiguities among stakeholders having various concerns. To date, there is no standard and common accepted way of conceptual description for such complex frameworks. To answer this lack, the proposed approach in this paper shows the need for sound design methods to derive educational systems from high-level descriptions. The three proposed structural diagrams permit to describe and represent engineering education curricula more abstractly, so as to minimize ambiguities among stakeholders and sustain flexibility in change. Common understanding of concepts and associations can thus be achieved. Moreover, managing flexibility and interoperability between educational systems and frameworks most often requires a tortuous work. For example, coping with incompatibility in semester course periods for student exchange is sometimes a tricky task. But having modeled each of the interoperating programs rigorously, and checked conformance with a same framework model, inconsistencies can be readily detected and more correctly addressed. As a first step for achieving interoperability, this paper exemplified the approach, with the CDIO framework as a proof of concept.

Educational system design and transformation involve many stakeholders. The proposal also permits to unify multiple views through an architectural modeling approach. By constructing educational system architecture as an aggregation of several coordinated models, specificities, properties and constraints can be addressed more explicitly. Using the proposed approach, it is easier to understand the relations among shared concepts and minimize ambiguities. Coherency issues can be addressed early at design time, which stops them from propagating during operating phases.

Interoperability between Various Frameworks

Another benefit of modeling educational systems with an architectural perspective consists in addressing the interoperability issues among different standards at a framework level. For example, if the relations between concepts from the CDIO standard and concepts from the EUR-ACE standard are described at a meta-model level, then some of the relations between models could be established and validated for all models/instances which conform to these models. It is sufficient that they are described only once, and thus can be systematically applied on instance models specific to an institution. This facilitates co-operation among institutions using different educational standards or frameworks.

Towards Educational Specific Notations

In this paper, we mainly focused on the structural modeling aspects using a UML-like notation. However, to date, UML is a wide set of graphic notation elements and thus permits also to represent and visualize behavioral views such as activities and business processes, or actors of a system. An architectural modeling language offers the advantage of a unified language, capable of describing a wide range of domains. It makes it possible to aggregate models of the enterprise or educational constellation, which can be more easily understood by all stakeholders. While this is very useful from a conceptual, informational and structural perspective, more details are often needed to deeply describe a system. The unified modeling language used in this proposal could lack the semantic strength required (e.g. some temporal or behavioral issues).

To go further, an Enterprise Architecture modeling language development method proposes to use a unified modeling language at the business level (e.g. processes), while using domain specific languages and methods at more detailed levels [23]. Domain Specific Languages allow experts to express, validate, modify solutions and achieve tasks specific to their domain. They require less cognitive design efforts from experts than a more general purpose language [24]. Thus quality, productivity, reliability, maintainability, reusability can be enhanced. In the engineering education context, we can propose as future work to design dedicated and more easily understandable graphical languages to facilitate adoption for non UML experts. Through appropriate notations and abstractions, expressive power focused on this particular problem domain will permit to visualize, specify, construct and document an educational framework more easily for the education community. To benefit from these advantages, the diagrams proposed in figures 2, 3, and 4 may be confronted with educational designers to imagine a Domain Specific Modeling Language as a profile for an Educational Architecture modeling framework.

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Biographical Information

Siegfried Rouvrais is a researcher in software and system architecture, involved in educational program design. He currently works as an Associate Professor at Telecom Bretagne Engineering School. Telecom Bretagne is a French *Grande Ecole* and a CDIO collaborator since 2008. Siegfried received his Ph.D. from the INRIA Lab. and University of Rennes, France, in 2002.

Vanea Chiprianov is a Ph.D. student in Software Engineering, with interests in Enterprise Architecture and Telecommunications. He has graduated Computer Science at Politehnica University of Timisoara, Romania, in 2007.

Corresponding author

Dr. Siegfried Rouvrais
Telecom Bretagne
CS 83818
F-29238 Brest, France
33-229-001504
siegfried.rouvrais@telecom-bretagne.eu
http://public.telecom-bretagne.eu/~srouvrai/