Implementation of a portable skills framework

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In this paper we describe a meta-framework for the representation of skills. That is, a framework in which different actual skills frameworks may be built. Our meta-framework provides the essential elements of structure which enable particular skills framework instances to be able to be related to each other. We explain the concepts of *Competencies* and *Educational Objectives* and how they can be used to foster interoperability between electronic systems. We also introduce the concept of *Facets* which serve to define ranges with a particular skill.

1. Introduction

This work was undertaken as part of the SPWS (Skills Profiling Web Service) project [1] funded under the Distributed e-learning tools programme of the UK Joint Information Systems Committee (JISC).

The project has created and implemented a flexible skills framework which supports a RESTian web service [2] offering reflective skills profiling (via an IMS Content Package [3]); this service is suitable for use within e-learning systems. The LUSID [4,5,6] personal development planning [1] (PDP) system is the service provider and the service is consumed within the Bodington Virtual Learning Environment [8]; both systems are open source and freely available from Source Forge. This type of service-centred approach is actively promoted by the UK's JISC as part of their e-learning framework [9].

The work on the skills framework has been necessary in order to define the structure of the profiling service.

2. Basic concepts

The background to this work was the recognition that in lifelong e-learning, PDP and e-portfolios generally, the representation and description of skills and competence plays a central role. Ideally, skills developed in one context should contribute to the evidence of potential competence in a different context. One can too easily imagine an employer being frustrated that a graduate or school leaver presents them with little evidence of the skills they need for employment. This may be because the relevant skills are simply not acquired; but increasingly it may be that they cover similar ground, but are represented in different ways. Both the individual skills represented, and the overall structure, may differ between different "skills frameworks".

Our challenge was to construct a skills "meta-framework": that is a framework in which different actual skills frameworks may be built essential elements of whose structure would enable particular skills framework instances to be able to be related together. This system will provide as much carry-over between the skills involved in episodes of lifelong learning and employment as is practically possible.

One central principle quickly emerged. We distinguished two aspects of skills frameworks: on the one hand a *conceptual* aspect, in which all stakeholders could realistically agree; and on the other hand an *operational* aspect, where the rich diversity of approaches to teaching, learning, assessment, and practice of skills could be

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[1] PDP is usually defined as *a structured and supported process undertaken by an individual to reflect upon their own learning, performance and/or achievement and to plan for their personal, educational and career development.* [7]

freely expressed while at the same time being clearly related to the common conceptual framework. Because we had decided to use the IMS RDCEO (Reusable Definition of Competency or Educational Objective)[II] [10] specification as the formal structure of both sides, we referred to the two sides as "C" and "EO": "C" for the conceptual aspect of competence, to be widely agreed, and "EO" for the diverse aspect which could well include "educational objectives" – a term related also to learning outcomes.

Having made this distinction, we found both that the "C" aspect was more tractable than the "EO", and also that the "C" aspect was the natural foundation on which the "EO" aspect would be based. We therefore focused most effort on the "C" aspect. The full implementation of a skills framework in a practical context would need the definition of the "EO" aspect as well, though much can be done with the "C" aspect alone.

Another major insight, which we brought from previous work, concerned the granularity of description of skills [11]. A coarse-grained concept such as "communication skills" invites much interpretation and debate about what elements it covers, whereas a much finer-grained concept such as "ability to set margins in Microsoft Word" is unlikely to cause disagreement in its definition or explanation.

These two ideas underpin Fig 1 which illustrates the essential relationships we are considering. We see the prime task for constructing a skills framework as the identification of a set of medium- to low-level *shared skill concepts*. These may be combined in different ways to construct the higher-level concepts which may suit different contexts. Each one may also be taught, practiced and (particularly) assessed in different ways, by different organisations with an interest in learners' skills: this could be thought of as "operationalisation".

Examples of shared skill concepts (which we also refer to as *skill topics*) which may be used in IT are: word processing, databases, spreadsheets, email, searching the Web, presentation packages, and so on. Similar concepts can be defined for other skills but it should be pointed out that one concept can appear in a number of contexts, for example, searching the Web is also part of an information accessing skill. The example cited above, "ability to set margins in Microsoft Word", would be considered to be part of word processing; if it made sense, one could define even more fine-grained skills connected with setting left margin, setting right margin, setting top margin and setting bottom margin.
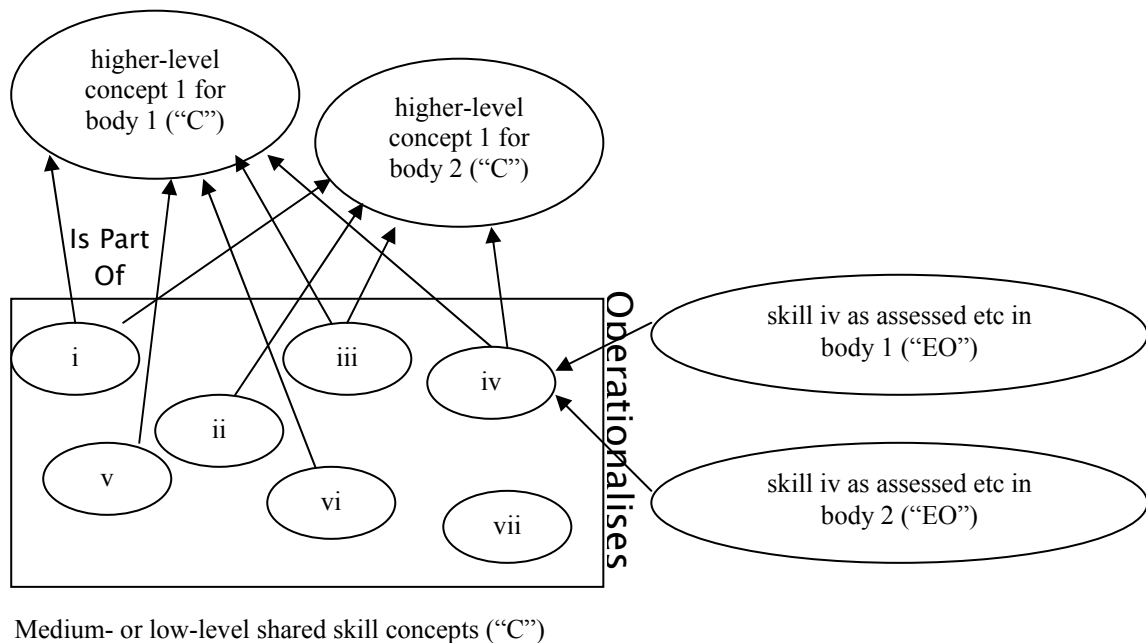
Fig. 1 Conceptual illustration of important relationships

In Fig 1, the left hand side represents "C", the right "EO"; the lower level represents a finer granularity, while the upper level represents a coarser granularity.

3. More detail on the conceptual aspect

We have found that the RDCEO specification is useful, particularly because it is relatively straightforward, but that it is limited in its precise matching to the needs of the emerging meta-framework. We have adapted it in various ways to suit.

One source of base material for the project was from the General Medical Council's *Tomorrow's Doctors (TD)* [12]; this describes what skills medical graduates should possess and is not unlike a subject benchmark [13]. It did reveal, however, that it is difficult to express target skills in this kind of domain within a structure that is logically well-structured. For the purposes of our work, we focused on a subset of the *TD* skill set. Even then we had to impose some structure.

This structure was partly needed to abide by rational principles which we propose for choosing plausible shared skill concepts. Where two skills are not practically distinguished, it is obvious that there is no need to distinguish them in a skills framework (and *TD* seems to follow this reasonably); but also whenever there are two parts of a skill that are practiced, taught or assessed separately, they should ideally be represented separately. In addition to this, for any framework to be used by learners themselves, it is important that the concepts are understandable by learners at their likely stages of learning and development.

To help the learner's intuitive understanding, and not to overburden a framework with very many separately represented skills, it is important to recognise dimensions or attributes of a skill, which we refer to (following information science literature [14]) as *facets*. These comprise one or more ranges, and the competence relating to different positions on those ranges are related, but not necessarily held together. We found an example in (medical) physical examination. There are four methods generally recognised (inspection, palpation, percussion and auscultation), which form one facet. A second facet proposed was the part of the body; a third was the physiological organ or system examined. Many other facets are found within medical (and other) skills, and we have proposed a way of representing these explicitly.

These points on facets are treated by us within the RDCEO "definition" structure, but when we come to relationships between skill concepts, the RDCEO structure poses more of a challenge. There is no explicit provision within the core RDCEO information model for the representation, for example, of the fact that one narrower skill *is a part of* a wider skill. But there is a "metadata" element, in which it is suggested that LOM-like metadata [15] is used. This may be plausible on the surface, but on closer examination we found that metadata for learning objects is not quite the same as metadata for competencies. Our proposals in this area were therefore somewhat provisional, and less than fully satisfying. We feel it would be better to move these relationships into the main body of the information model – in other words introduce a *relationship* element to RDCEO. Perhaps this might be combined with a restructuring of the proposed metadata, based more directly on Dublin Core [16], not via LOM.

For classification (in terms of established classification schemes, such as Dewey, MeSH, etc.) the metadata as proposed seemed quite reasonable. In principle, the classifications of skills should enable automatic searching and retrieval of relevant learning materials and literature, if they too are classified within the same schemes.

For demonstration purposes, we have put together a very small conceptual skills framework– that is "C" not "EO" – drawn from the LUSID set. This is available at http://www.inst.co.uk/clients/jisc/SPWS/skills/ at present.

4. Relating to frameworks with levels

One challenging aspect dealt with in considering a meta-framework was how this should relate to existing skills frameworks, many of which are constructed with a central concept of *level*. Considering the state of the art, including the examples of the European Qualifications Framework [17], and the Skills Framework for the Information Age (SFIA) [18], we concluded that levels most properly belong to the "EO" aspect of skills frameworks, rather than the "C" aspect. Even within the scope of the "EO" aspect, it seems implausible to establish

one standard for levels, because each level system may relate to a distinct context and purpose. Usually levels relate to progression in some way, but we recognised that, increasingly in lifelong learning, different progression pathways can lead to the same eventual outcomes of competency. Hence our proposals exclude any explicit level structure in the meta-framework, leaving such structures to be implemented by creating framework-specific information (perhaps as an extra RDCEO "definition" element) within "EO" frameworks.

5. Connecting to the "EO" aspect

This leads naturally on to considerations of that "EO" aspect, though, as mentioned above, we did not do much practical work down this avenue.

We see "EO" skills frameworks as practical implementations, or operationalisations, of an agreed conceptual "C" skills framework, where that "EO" framework is typically proper to one actual or virtual body or organisation (educational institution; professional body; association; employer; etc.). The principle to keep hold of, (which is vital to enabling the relationship between these "EO" frameworks,) is that skills in an "EO" framework need to be related to corresponding skills in an agreed "C" framework.

We see the construction of "EO" frameworks as inherently more complex than "C" frameworks, though requiring less negotiation, as they do not have to be agreed. In particular "EO" frameworks have to deal with assessment: it makes much sense for learners to be able to find out how their skills are going to be assessed in their current learning context. Following our thinking on facets, it made sense to provide a general-purpose set of three facets, covering who assesses the skill; the basis of the assessment; and what enduring evidence could remain (see Table 1). The range of potential options for assessment can be spelled out as part of the "C" aspect, while the actual method can be given as part of an "EO" framework.

who assesses	basis of assessment	what enduring evidence
learner human marker of records automatic marker of records expert judge (assessor or practitioner) peer or peer group client or client group	learner's self-awareness learner's choices learner's responses learner's statements learner's action/performance learner's product consequences or outcomes group performance group product	the basis of assessment certificate/transcript witness statement/ testimonial survey results photographic audio recording video recording

Table 1 Ideas for facets of assessment

Non-assessed "EO" skills can be taken to be very similar to private "C" skills. Other items in an "EO" assessment framework could be thought of as summaries of competency. For example, the overall marks for a year on a course might be composed from module marks, with certain logical requirements; and module marks in turn from marks on units, or examinations. Explicit composition rules should be represented somewhere to document how the overall assessments are composed from their parts. This really requires further work bridging the domains of competency and assessment. Standardisation needs therefore to consider the different related specifications.

In all assessment frameworks, there will necessarily be assessments which are not composed of lesser assessments. These may be results on individual assessment questions, or other evaluations. The representation of these within a formal skills framework should clearly define the assessment method, and the characteristics of the assessment should fall within that defined by the assessment potential facets of the related "C" competency concept.

6. Further work

Beyond this work on integrating assessment, there are other areas which would benefit from further development.

To make even the "C" frameworks practically usable there need to be registries of facets and vocabularies, and the skill and competency definitions themselves. These would naturally be held by a body independent of any institution which actually teaches and assesses those skills (and which therefore may well have its own "EO" framework in the same area).

As suggested above, the RDCEO specification could benefit from attention, so as better to allow some of the features which were not explicitly envisaged when it was first drafted. Arguably this could be done after the first round of practical prototypes of implementation, which themselves could initially use the suggested approaches generated by this project.

To reap the maximum benefit from the interoperability of skills definitions, there would need to be a development of the culture within educational institutions, so that the construction and maintenance of their "EO" frameworks became an integral part of the development and maintenance of their learning materials and assessment regimes. This could be seen as an extension of current initiatives, both to define learning outcomes for each educational activity, and to relate learning outcomes to independent definitions such as subject benchmarks, or definitions constructed by the appropriate Sector Skills Councils.

To avoid fruitless debate on the nature and role of levels, stakeholders may wish to weigh up whether any particular idea of levels can plausibly ever become a universal standard. It may be better to tie levels to particular contexts, and particular "EO" frameworks, where they can provide useful structure. These contexts might include qualifications frameworks intended to assist with pathways and progression.

7. Further information

This document is effectively a summary of one of the main SPWS deliverables *A skills meta-framework for UK education.* This document is contained on the project web site which also houses more information including an actual instance of the framework (200+ IMS RDCEO files). Visit the URLs given in [1] for more information.

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