A Life-Cycle Model for the Quality Evaluation of Educational Content

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Abstract: In this work we present a life-cycle model for the quality evaluation of digital educational content suitable for open and distance learning. This model, being the first step for designing a Quality standard, utilizes elements (views) from project and product life-cycles as defined in formal Management procedures. The result is a mixed, multi-step educational-focused process, which covers all aspects of content life: from inception, to design and production, use (and re-use) to evaluation and improvement.

Keywords: Digital Educational content, Lifecycle Model, Assessment, Quality Assurance on e-learning

1 Introduction

A new stage is set for the transition to the paperless University; International efforts plan for a full transition of University teaching material from paper to digital form within the next few years. Battling with poor awareness, Education Institutions need now to face a dual role as publishers and distributors of educational content. Standardization of the procedures used for designing and developing such content is one of the many challenges ahead. Quality standards and techniques have been successfully used for evaluation of systems and software throughout their lifecycle. However, research on content (viewed as data), and especially digital assets used for educational purposes, is somewhat behind as far as formal quality evaluation techniques are concerned [Arrascaeta Farrando, 2007].

Standardisation of educational content design, development and management requires not only standard business processes but a meaningful evaluation of the educational process itself. Questions on how tutors set goals and how the

educational content is designed around those goals, how content is consumed by stakeholder and in which way, are some of the key research questions. Current practise relies on guidelines or the transfer of best practices. To the best of our knowledge, there is no educational-specific or formal standard which certifies the educational process or educational material except ISO19796 [Pawlowski, 2007]. However, this standard is more a reference model rather than a standard in the strict sense of the term. Ther are also some interesting, process-based approaches [Stracke, 2010].

In this paper, we address the problem of how to design digital educational content (and in particular content suitable for open and distance learning) based on formal quality and assurance practises. We present a new framework for the quality evaluation of digital material mapped to its life-cycle process: quality control procedures are mapped to every step, from initiation and design to dissemination via Learning Management Systems. Assessment is not a simple procedure, since digital content is not as simple as data is and thus ISO standards are not directly applicable. We argue that educational, technical and managerial principles need to be applied in order to obtain a complete, flexible and practical model of evaluation.

The paper is organised as follows: in section 2, a categorisation of digital educational content is made while in section 3 we address in short, the main Q&A streams in the international domain and pose the basic research questions. In section 4 we present the lifecycle model and in 5, future research directions.

2 Educational Content management at HOU

Hellenic Open University (HOU) is the sole, state-funded Greek University, which provides open and distance learning for over than 15 years. The University uses formal standards such as ISO9001:2008 and ELOT:1429 for the standardisation of managerial procedures. It also operates two permanent, independent units devoted to Q&A: the Evaluation Unit for the yearly assessment of academic staff, educational content and administrative services; and the Q&A Division of the Educational Content, Methodology and Technology Laboratory for the quality management of the design and development process of the educational content. The two units have a long history of over than 12 years of Q&A; more than 30.000 students per year participate in the assessment of the 300 books, 500 hours of video lectures and Gigabytes of supporting learning material included in HOU's ciricula. An on-going effort aims at producing a large amount of digital content including Wikis, hypetext, animations and podcasts by 2015.

Experience has shown thay the quality of educational content (also referred to as teaching material or educational material) is a critical element in the quality of education. Especially in the case of distance education, it is of primary importance since there is no direct, physical presence of a tutor and content provides (besides knowledge) guidance, self-assesement and practical experimentation.

Educational content is not only diverse educationally, but technically as well: it can be roughly distinguished in printed and digital material. The printed form includes study books, which are available to students in paper or electronic form. Digital content is defined as the artefact, which combines digital content, and dissemination media (digital content container) or an application system. For example, in a digital learning material, content is text, the technological means is an application overlay (e.g. browser) while the pedagogical / didactic application is the context in which the application is used (e.g. a training module). Digital educational content may take many forms each of which is stored in a number of different formats. The basic types of digital educational content are text, audio, graphics, video and animation.

3 Quality and educational content: research questions

Quality management in Higher Education is mainly based on the application of the ISO9001: 2008 standard and relates to administrative procedures. A variant of ISO 9001:2000 for educational institutions appeared in the form of the International Workshop Agreement Part 2 (ISO IWA2: 2007) [ISO-IWA 2, 2007]. It contains general guidelines for the implementation of standard business processes within the organisation mainly replacing stakeholders of ISO9001 with educational stakeholders. On the other hand, examples of adoption of standards or guidelines in Universities are found in the UK (full frame mode Universities [QAA, 2011]), the USA (for instance in the context of Good Operating Practises in Cornell [Cornell, 2011]) and in many European countries [ENQA , 2011]. Reports avoid referencing to the use of standards in functions other than those of administrative nature.

It is important to stress the link between educational processes and the education content being used by them (for example during teaching a class in winter semester). Educational content and learning processes are closely interconnected.

To date there is no documented case of adoption or effort to design standards for assessment or certification of educational content. The strategy of some Higher Education Institutions to adopt reference frameworks or guidelines

instead of strict standards of educational processes raises the following question: is it feasible (and applicable) to formalise the procedure of producing educational content using a (new) standard? If so, a quality standard for educational material due to its nature (implementation in an academic environment, the need for practical guides) should be designed using a mix of techniques that insure formality, practicality and completeness. In order to design such a standard, one has to answer at least the following research questions:

- **What to measure?** Educational content has a diverse nature including educational, pedagogical and technical facets. Parameters such as functionality, educational suitability, educational correctness, content delivery, (self-) assessment, subject coverage and many others form one body, but they are different parts. Intrusively, different thinks must be assessed (qualitatively speaking) through different methods/tools. What is the best method to asses which part?
- **How to measure it?** The general concept of quality is neither measurable nor strictly defined clearly in the field of distance education because high quality educational content requires to reference quality, quality assurance procedures, compliance and quality-of-course to the human factor (i.e. how humans learn).
- **How to be practical:** Standards are general enough to maintain their correctness regardless of how and where they are implemented. This generality reduces their practicality and has attracted a great deal of criticism. However, it is possible to 'enhance' the practicality of a standard by including application guidelines (directions on how to apply it).

4 A life cycle for developing educational material

The development of digital educational content requires both running a project (with analysis, design and development phases) and producing a product (data view). The first step in producing a standard for digital educational content is to analyse in depth the processes of these two directions that are combined: processes and data.

The development of educational content can be regarded as a project, an approach also followed by the ISO19796 standard (which however is more general, covering a wide range of training applications) [ISO 19796-1, 2005]. The implementation of a project includes the following steps: setting the goals and objectives, design, implementation and continious evaluation by stakeholders. The sum of the phases of the project form the project lifecycle. When a project

for developing educational content is initialised, the goals must be clear. The process must follow the rules of project management (needs analysis, recruitment of appropriate staff, continuous evaluation of results vs. objectives etc.).

#	Phase	Processes
1.	Needs Analysis	1.1 Initiation
		1.2 Stakeholder definition
		1.3 Define goals
		1.4 Define Requirements
2	Design	2.1 Define Educational Objectives
		2.2 Define content type and distribution media
		2.3 Select didactical method
		2.4 Define level of interaction with the stakeholders
3	Development	3.1 Create content
		3.2 Encapsulate content into distribution media
		3.3 Pilot use
		3.4 Internal evaluation
4	Management	4.1 Use
		4.2 Re-use
5	Assesment/Impovement	5.1 Assesment 5.2 Design improvements 5.3 Improve content

Table 1. *Description of the digital educational content life-cycle.*

If the educational material is regarded as a product (data, knowledge or information) then instead of Project Life Cycle, the term Product Lifecycle is used. The latter contains the former. The life cycle of the product initially contains a business plan, the duty cycle that produces the product, and most importantly, further steps concerning operation (use) and upgrading. The life cycle of digital educational content should incorporate basic parameters such as data idiosygracies, this osmosis between the educational environment and the stakeholders, instructional design and assessment processes. The lifecycle is designed as a mixture of the two cycles mentioned in the previous section (Table 1) and includes the main phases of the project life cycle that produces educational material, enriched with phases and processes that map to a product life-cycle.

The life cycle includes five basic steps:

- **Phase 1: Requirements Analysis.** This phase includes processes such as:
  - ✓ Setting the initial idea and the overall objectives as well as the needs that lead to the development of educational content and making initial predictions about the type of educational materials, the financial budget and the delivery method.

- ✓ Defining stakeholders: who will be involved and how.
- ✓ Setting Goals: setting out the basic project parameters such as the target group (e.g. distance learning, adult education, skills-training), complex types of educational content, duration of use and needs for educational support material (technical, scientific, clarifications).
- ✓ Finally, defining requirements: defining the specifications of education material such as content, teaching methodology, technical specifications, interaction and interface.

- **Phase 2: Design.** This phase includes four procedures:
  - ✓ Definition of the educational objectives: which are the educational objectives and which in-content educational scenarios will be mapped to them.
  - ✓ Define content type: select the type of learning materials (digital, LO, multimedia, hypertext) so as to reach the educational objectives in the best possible way.
  - ✓ Selection of didactical methods: selection of method(s) by which to implement the educational scenarios (build knowledge, knowledge transfer, etc.). At this point, a more detailed design of the scenarios defined in 2.1. takes place.
  - ✓ Level of interaction: optional process related educational content offered through LMS and/or requires special design features so as the user interacts with the system.
- **Phase 3: Development.** In this phase, the authors of learning content develop and deliver the content according to the educational objectives set and target group requirements. This phase includes the pilot use of the content as an optional process followed by internal assessment. The latter, is used to study the satisfaction of user expectations (educational objectives, expected functions, educational environment) at an early stage (before the product reaches the customer).
- **Phase 4: Management.** Stage 4 includes all processes involving the use of educational materials (although it is often ignored, it involves considerable indirect costs). In some cases, the use of educational content includes management tasks in e-environments such as an LMS. Educational content can be reused if it has the appropriate format (e.g. LO format), as a whole (for other educational purposes) or partly (to synthesize new training content).
- **Phase 5: Assessment/Improvement.** The last phase includes processes involving evaluation and improvements that can be made in the content after it has been delivered for use. The external assessment involves assessing the quality of educational content as perceived by the user. Design

modifications involve repetition (of all or of some) of the processes of phase 2. A meta-evaluation process is also possible as an extra feedback step: it essentially examines the effectiveness of the instructional design by taking into account the qualitative and quantitative interpretation of internal metric values. Assessment processes either lead to the acceptance of content for use as is or trigger improvement processes.

Having taken into account the already established Quality Control processes of ISO9001 as they are applied and used in various stages of phases 1,2,3 and 5 at HOU, a group of stakeholders for all phases is designed (table 2).

Stakeholder	Role
Specification expert	Sets Specification on: • didactical methodology, • technical parameters • interaction interface.
Designer/Developer	(Re-)Desings content • Sets educational objectives • Sets learning paths Develops content
Quality Control Team	
Quality Control	• Technical control • Educational control (including controls on objectives, goals, learning paths, bibliography, connection to real-life examples etc.)
Internal Assesment	
Reviewer (Subject expert)	Scientific control (scientific corecteness, clarity and coverage of topics).
Reviewer (expert on open and distance education)	Controls open and distance education characteristics (self-assessment mechanisms, student motivation triggers, learning style etc.)
External Assesment	
Users (students, tutors)	They use the material in real-life situations and continiously (at least yearly) formally asses its educational and technical quality.

Table 2. *Stakeholders of the digital educational content life-cycle.*

5. Conclusions and Future Work

In this work we presented the first step towards a formal standard for the quality evaluation of digital educational content by designing the life-cycle model for its development, assessment and use. Our appoach is based on the quality standards ISO / IEC 9126, ISO / IEC 25000 series and especially on ISO / IEC 25010,

the ISO / IEC 25012 (SQuaRE quality model-Data quality model) and ISO 25020 (measurement method). Initial results have produced a mixed data and process standard with 7 quality characteristics, 30 sub-characteristics and 72 metrics. We intend to validate this standard on the on-going production of digital educational material in order to assess its usefulness, practicability and make adjustments for a final version.

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