SEQUENCING OF CONTENTS AND LEARNING OBJECTS – part III

SECUENCIACION DE CONTENIDOS Y OBJETOS DE APRENDIZAJE (III))

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Abstract: This is the third part of the article under the same name published in the previous issue of RED. It was then that we stated a vision of the selection and sequencing of learning objects in the context of curricular planning, from the constructivist perspective. In the field of web-based training, we pointed out the importance of having tools and autonomous criteria that guide this process on our own and on external basis, above the prescriptions of technological tools, and from the need of having standardized formats to exchange data.

The above mentioned becomes more relevant in the field of e-learning for general purposes, in the areas of academic formation, corporate and general training. It covers the area of formal, non-formal and informal education as well. We have also mentioned the needs the e-learning industry has to fulfil at present in relation to instructional design of learning objects. These needs are both a priority and a challenge.

In the first part of this article we developed the constructivist perspective and the concept of technological tools as educational resources, as well as a revision of concepts that are related to e-learning, learning objects, reusable learning objects (RLO) and reusability. In the second part, we dealt with the basis for the theories that rule the procedures for selecting contents, the basic presupposition and the description of the sequencing techniques. In particular, we focused on three of them: Content Analysis Technique, Task Analysis Technique, and Elaboration Theory.

In our third and last part, we undertake several issues – not trying to solve them but just in their proposal as enunciation: Is the concept of reusable learning object compatible with the requirements of interdependence of the learning contents? If this is so, what are the requirements for those learning contents?

Keywords: Learning objects, reusability, usability, learning technology standards, e-learning, curricular design, content sequencing, Content Analysis Technique, Task Analysis Technique, Elaboration Theory.

Resumen: Esta es la tercera parte del artículo del mismo nombre publicado en el número anterior de RED. En él planteamos una visión de la selección y de la secuenciación de contenidos de enseñanza, en el contexto de la planificación curricular, desde la perspectiva de las corrientes del pensamiento constructivista. Señalamos la importancia de contar, en el campo de la formación apoyada en redes, con herramientas y criterios autónomos que guíen este proceso desde unas bases propias, externas y con preeminencia sobre las que derivan de la configuración de las herramientas tecnológicas, y desde la necesidad de contar con estándares de formato de intercambio de datos.

Si en general este planteamiento es importante adquiere especial relevancia en el contexto del *e-learning* de propósito general, tanto en el de formación como en el *e-learning* empresarial o en el universitario. Y por supuesto en el contexto de la formación reglada y de formación informal, o de la no reglada. También señalamos las necesidades que plantea la industria del *e-learning* en la actualidad en relación con el diseño instruccional de objetos de aprendizaje, necesidades que constituyen una prioridad y un desafío.

En la primera parte, desarrollamos la perspectiva constructivista y la conceptualización de servicios y herramientas tecnológicas como recursos educativos, así como una revisión de los conceptos vinculados con el *e-learning*, objetos de aprendizaje, OAR y reusabilidad. En esta parte abordaremos la fundamentación de las teorías que rigen los procedimientos de selección de contenidos, los presupuestos básicos y la descripción de las técnicas de secuenciación. En particular nos centraremos en tres de ellas: La *técnica de análisis de contenidos*, la *técnica de análisis de la tarea* y la *Teoría de la Elaboración*.

Por último como conclusión, en la tercera parte, intentamos abordar, no en su resolución sino solo en su propuesta como enunciado, varias cuestiones: ¿el concepto de objeto de aprendizaje *reusable* es compatible con los requisitos de interdependencia de contenidos de aprendizaje? Y si es así ¿qué requisitos han de cumplir éstos?

Palabras clave: Objetos de aprendizaje, reusabilidad, usabilidad, estándares de e-learning, e-learning, diseño curricular, diseño educativo, secuenciación de contenidos, Técnica de Análisis de Contenidos, Técnica de Análisis de la Tarea, Teoría de la Elaboración.

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CONCLUSIONS

Simplifying, we can say that in the world of distance learning there are two tension poles: that of the open resources and that of the industrial production. The first one is represented by the MIT's OpenCourseWare(OCW)[1] from the Massachusetts Institute of Technology[2] and the second one is represented by the ventures of the e-learning industry and the US Department of Defence[3].

In the first case, it's a matter of sharing open resources and the ethics of hackers[4] (Himanen, Pekka. 2002) through simplicity, emphasizing not the complete but the close feature of resources, but the methodology, the tutorial and evaluative intervention, the personal attention and the excellence in the achievement of learning objectives (in the acquisition of concepts and skills, as well as in the performance of procedures). In the second case, the emphasis is also in the acquisition of learning objectives, but in the interest of more efficiency in terms of cost, more emphasis is laid on the self-sufficiency of tools and resources (platforms, multimedia, etc.).

These self-sufficient systems imply more technologically complex data formats for curricular resources, where a large number of automated or semi-automated pedagogic functions have to be attended. This is even more so in the case of organisational functions or functions that are half-way between organisation and pedagogy, mainly in the fields of e-learning industry and of technological research.

The richer the automation of educational, teaching, etc. functions or functionalities, the greater the need to have environments that are friendly enough to overcome the roughness or slowness of the computer environments, and the difficulties in

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[1] http://ocw.mit.edu/index.html

[2] http://web.mit.edu/index.html

[3] http://adlnet.org/index.cfm?fuseaction=adlhist There is a complete list of companies that have adopted SCORM standard on this page.

[4] This system of ethical ideas has its origin in the attitudes of the primitive hackers -altruistic and passionate programmers who programmed and offered his job openly and for free- has its most complete study and definition in Pekka Himanen's *The Hacker Ethic and the Spirit of the Information Age.*

communication and relationship between users. Another complexity is the fact that adding operations to resources implies more complexity when designing standards for exchange, transportation and interoperability. It is becoming more and more difficult to find standard formats. In a way, this means to fall in a spiral of complexities.

Let's leave aside, then, this tension between open and industrial systems –The first ones do not present problems in connection with transportation, integration or re-usage as they use standard formats for data and procedures (PDF for documents and HTML, XML or JavaScript for multimedia or animations) to solve these problems. The second ones add a new tension to the one already mentioned –to make the quality criteria consistent in that the more teaching and cognitive functionalities a format bears the better it will be, compatible with the technological criteria of transportability, integrability, and reusability. This tension, inherent to the own concept of corporative e-learning, is the one that determines the pole towards which all development and research efforts should be attracted to.

To conclude, we will attempt to approach several issues at a general level, just to mention them. The first issue is a basic and preliminary one: Is the concept of reusable learning **object compatible with the requirements of interdependence of learning contents**? And, what requirements should be fulfilled in order to make sure they stay compatible?

Next, we will necessarily have to set a number of issues: How can or should sequencing criteria be applied to learning objects? How should they be applied in the design and elaboration stages? How should they operate in the execution stage? Which are the data, information and criteria added to information of other kind that is attached to the learning objects? Is it done as a support of the educational intervention or in an automated way?

Besides, it would be necessary to analyse if the efficiency of this type of system makes the technological outcome one that is too complex, or if it impairs learning, to what degree and if it is worth. Can technology answer to issues as complex as those ones, or can those issues only be handled by expert knowledge from personal, non-automated tutorship intervention?

We will illustrate these issues with examples. We will deal with the general aspects first and then we will limit ourselves to examples on the sequencing technique through content analysis.

GENERAL ISSUES

We know that the aim of sequencing is to establish an order in the learning objects that guarantees **the link between educational objectives and students' learning activities**, in such a way that the organisation of the activities ensures the realisation of the formative intentions of the formative programme, educative community or institution.

In other words, the sequencing of contents, tasks and activities should promote a progressive approach from the students' initial stage towards the goals of the formative programme set by the educative community or institution; and both the initial stage and the

goals are different for each group of students, for each individual, for each formative programme and for each institution. Therefore, explicit information should be given, and it should be consistent with each of the situations in which the process takes place. Besides, the object of study should not only be how the information is organised, but also how it is applied whenever feasible, or how it is supported – through personal tutoring, through individuals and computer mediated, or automated using computer tools.

Criterion **Sequencing of contents, tasks and activities**	**Variables:** **Sequencing should, at least, be adapted to**
♦ It should promote a progressive approach from the students' initial stage towards the goals of the formative programme.	♦ Each group of students ♦ Each individual ♦ Each formative programme ♦ Each institution

Another basic tenet is that the **learning contents of an area of knowledge are interdependent. Therefore, the order in which they are presented is relevant to learning**.

A certain learning object in a certain context, within a certain order and to be used at a certain moment will deal with a situation of concepts and previously developed procedures in that or other areas which will have different cognitive scaffolding: advance organisers, inclusive concepts, implicit ideas, etc. to different formative contexts, target groups and individuals.

Whenever a learning object or a content unit (concept, procedure …) is introduced, it is necessary to make sure the general character of that principle is respected.

Because this general principle is not operative in itself, it will not lead us into a valid rule or procedure for all cases, but it can inspire the procedures for contextualisation of a learning object. We will probably arrive to the conclusion that it is not possible for 100% of the cases. So, it is very likely that there will be redundant concepts or contradictory situations that clash not only with the principles of constructivist learning – deriving into cognitive conflicts-, but also with the rules of logic (*what is being defined should not be part of the definition; not to use later concepts to define prior concepts* for support, etc.) The question is then, **how to go on – to automate procedures or to adapt the environments for these functions**.

Learning Contents	Learning Objects
from a certain area are interdependent	**change according to function in the curricular context.** A certain learning object, placed in a certain context within a sequence and to be used in a certain moment will have a situation of previously developed concepts and procedures in that area or in other ones which will be different from any other situation.
are set in a certain order which is relevant to learning	**change according to position in sequence.** The students' learning situation will, in general, also be different in relation to cognitive scaffolding: advance organisers, inclusive concepts, implicit ideas, etc. for formative contexts, target groups and even for different individuals.

At a more particular level, any of the considered techniques for sequencing contents has clear implications not only for the *instructional design* of the learning objects but also, and above all, for the creation of the objects proper.

A more detailed study would lead us to an analysis of those implications in relation to, at least, the three techniques mentioned above. However, the aim of this paper is not to go deeper into the issue but just to mention it, drawing attention on this need. Therefore, we will limit ourselves to make some comments on the *Content Analysis* technique.

From the above, at least, it can be concluded as example for the general procedure that:

Phase in the procedure	Implies (*reusability* criteria)
Discover and point out the backbone of the contents that have to be taught to students.	that for the learning objects, in the accompanying information and in their instructional design (suggested activities, references, examples, etc), the backbone of the formation programme should be included. And if this is not the case, a generic treatment should be applied to avoid particularisations, so that if it is useful for a particular course or subject, it is not for another, making it *non-reusable*. For instance, it is not the same to deal with the topic "derivative" in Maths for the representation of functions than to deal with it to solve problems of maximums and minimum, or to solve other type of problems.
Discover and point out main contents and organise them in a hierarchical and relational way.	that the objects comes with a content map organised in a hierarchical way according to the chosen backbone.

Likewise, the implications that the principles that rule the psychological organisation of knowledge have for the RLO can be considered:

Principle	Implication
All students can learn a certain content significantly provided they have the relevant and inclusive concepts within their cognitive structure.	All objects should consider prior contents (concepts, procedures …) as indispensable information; and they should only be designed taking them into account. Moreover, it is necessary to ensure that they have the convenient skills and that it knows its sense and interpretation.
In order to help the student achieve a progressive differentiation of knowledge –i.e. incorporate new element to their cognitive structure so as to enrich and diversify the initial inclusive elements- and a later integrative reconciliation –i.e. the coherence of the set of concepts in the cognitive structure- the learning sequences must be ordered from the most general concepts to the more specific ones, in a progressive way.	The treatment of a diversified content in an object later than the object containing the content of origin should be ensured. For example, in language-grammar-syntax, compound sentences should not be dealt with before simple sentences.
	The same can be said for the rest, that is, in relation to objects dealing with inclusive concepts, etc.

With these criteria, following the analysis of learning content, we get to a set of operative requirements that lead to a definition of *sequenceability* of the reusable learning objects. Naturally, it is important to insist on the fact that it is a complex process as the sequence of contents does not necessarily correspond to the "natural or logical" sequence of contents; so, *sequenceability* could have, as source, different analysis criteria on how concepts and ideas (content analysis) are formed or they can originate in tasks analysis or Elaboration Theory. Moreover, the existence of learning objects that are *not sequenceable* could come out as a conclusion.

In any case, we believe these thoughts, this analysis and effort will help us get closer to make contents more attainable to the students in the sense that they will be able to get a sounder acquisition of them.

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