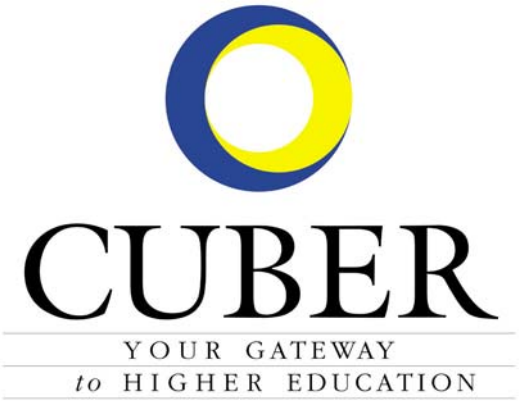


PERSONALISED CURRICULUM BUILDER IN THE FEDERATED VIRTUAL

UNIVERSITY OF THE EUROPE OF REGIONS

Contract No: IST-1999-10737

FINAL REPORT, IMPACT ANALYSIS AND BEST PRACTISE REPORT

Deliverable D9.2

Authors:

Gottfried S. Csanyi, Universität Linz (Austria)
Elisbabet Galindo Ramos, Universitat Oberta de Catalunya, Barcelona (Spain)
Heli Kautonen, University of Helsinki (Finland)
Jörg Keller, FernUniversität Hagen (Germany)

The CUBER project is supported by the European Community in the IST Programme of the Fifth Framework. Nevertheless the content of this document does not represent the opinion of the European Community, nor is the European Community responsible for any use that might be made of data appearing therein.

Administrative Data Summary

Project Number:	IST-1999-10737
Project Title	CUBER – Personalised Curriculum Builder in the Federated Virtual University of the Europe of Regions
Deliverable Type:	Public
Deliverable Number:	D9.2
Due Date of Deliverable:	31. 3. 2002
Title of Deliverable:	Final Report, Impact analysis and best practise report
Contributing Workpackage(s):	Workpackage 9
Nature of Deliverable:	Report
Author(s):	Gottfried S. Csanyi (Universität Linz, Austria), Elisabet Galindo Ramos (Universitat Oberta de Catalunya, Barcelona, Spain), Heli Kautonen (University of Helsinki, Finland), Jörg Keller (FernUniversität Hagen, Germany)

Abstract	This report presents the results and findings of Workpackage 9 "Credit Point System Integration". First, it briefly summarises the state from Deliverable 9.1 (Intermediate Report) and completes the algorithms described there by assigning values to all threshold parameters and by detailing the comparison of course contents. Second, the report extends the exchange of courses within the CUBER database to exchange with third-party courses, about which metadata are supplied by the prospective student using the CUBER system. Issues here are convenient input of such data and a check by the CUBER system, whether such data are reliable, i.e. can be trusted by the system to an extent that allows to compute an exchange recommendation. Third, the exchange algorithm itself is evaluated by comparing its decisions with decisions made by degree-granting institutions on the basis of identical metadata about a set of test courses. Derived from the evaluation are recommendations for best practice of the acquisition of relevant course metadata and of the choice of parameter values. Last, an evaluation of the ECTS implementation at the Universitat Oberta de Catalunya serves as a best practice report on how to proceed when assigning ECTS credits to courses, which is a necessary prerequisite to applying the exchange algorithm.
Key words:	course acknowledgement, exchange algorithm, ECTS implementation

Distribution List:	CUBER project BSCW system, European Commission
Issue	1.0
Reference:	D9-2.doc
Total Number of Pages:	See footer

TABLE OF CONTENTS

1. Introduction

The goal of Workpackage 9 "Credit Point System Integration" is to investigate, to what extent an automation is possible for the decision whether a course in a study programme can be exchanged against another course, and what prerequisites are necessary herefore. Such an exchange is helpful for prospective students wishing to customise a study programme to their needs and for prospective students wishing information about the acknowledgement of previous study success.

In the first half of the time period allocated for workpackage 9, we concentrated on the exchange process itself and developed, on the basis of current acknowledgement practice surveyed, an exchange algorithm for the different possible scenarios (mandatory courses, courses from a catalogue with choice, and so on). This exchange algorithm, which will be briefly explained in the next section, is able to operate on the metadata structure already present in the CUBER system.

In the second half of the workpackage, the work from the first half has been completed and complemented. First, as the exchange algorithm is parameterised, values for all relevant parameters had to be found and agreed on. These are presented in Section 2. While a set of parameters has been agreed on by all WP9 partners, these values can as well be provider specific, so that each institution is free to parameterise the exchange algorithm to best match their local regulations and practice.

Second, the exchange scenario has been extended to exchange a CUBER course by a course from a third-party provider. The extension covers the cases where a prospective student wishes to customise a study programme referenced by CUBER via inclusion of external course material, and where a prospective student wishes to have prior study success with institutions external to CUBER acknowledged in a study programme referenced by CUBER in order to get his degree faster. To apply the exchange algorithm in these situations, the prospective student must provide the relevant course metadata. This shall not take too much effort, because user acceptance of this feature will be low. Recommendations for user input are given in Section 3. Additionally, the CUBER system now has to work with data it cannot trust unconditionally. Therefore, plausibility checks have to be applied and constraints on the possible recommendations developed to guard against nonsense data. The recommendations to this end are presented in Section 4.

Third, the exchange algorithm itself has to be evaluated, in order to validate how closely it matches current acknowledgement practice, and to be able to give recommendations for best practices when inputting relevant course metadata and when adapting parameter values. The evaluation has been done as a two-sided field study between Universidad Oberta de Catalunya and FernUniversität Hagen with carefully chosen existing courses. The results of this evaluation are presented in Section 5.

Last, a necessary prerequisite for the application of the exchange algorithm is the assignment of ECTS credits to courses. This is normally done as one out of many steps when an institution joins the ECTS system. However, many institutions have not yet done so for a variety of reasons, and this is also not required for the application of the exchange algorithm. Only the assignment of credits is required. The field study that evaluates the implementation of ECTS at the Universidad Oberta de Catalunya can

serve as a best practice report for institutions in the phase of or planning to implement ECTS credits. This field study is presented in Section 6.

Our work has proceeded much further as we dreamed when we started the CUBER project. Hence it is with pride that we learn how a simple variant of the exchange algorithm is about to be included in the CUBER search engine prototype. We all would hope to see more of our work included into the CUBER system during the exploitation phase.

2. Threshold Values for Comparison Parameters

In order to compare two courses, the following fields from the metadata scheme are used:

5.13 ECTS (if this is not available for A and B, 5.9 Typical Learning Time might be used).

5.15.2 Method (the principal examination method)

5.6 Context (the principal environment in which the course is used, such as undergraduate…)

1.6 Keywords (description of the content)

In the basic scenario, where both courses are mandatory, a course B is allowed as a substitution of course A if the following four conditions are all satisfied:

1. B.ects >= α * A.ects
2. B.method >= A.method
3. B.context >= A.context
4. match(A.keywords,B.keywords) >= β

For the parameters α and β, threshold values of 90% and 70% were agreed upon among the participating partners. However, these values could as well be site-specific.

To compare method and context, appropriate orders have to be defined on the possible values. This can be done in a straightforward way, e.g.:

oral exam >= exam >= assignment >= presence >= enrolment

postgraduate >= graduate >= undergraduate >= general studies

More elaborate rules are of course possible, where presence could for instance be recognised as equivalent to assignment.

The function match returns a value between 0% and 100%. This value should reflect, how much of A's content is covered by B. In its simplest form, one can count how many of A's keywords are present as B's keywords, and divide this value by the number of A's keywords. A refinement would be to give each keyword a weight which is the number of ECTS credits of this course divided by the number of keywords of this course. A keyword match then contributes the minimum of the weights of the matching keywords. The total count is divided by A's ECTS credits to achieve a percentage. For a further refinement, see section "Evaluation".

An other refinement of values could be considered in changing the values for the α and β parameters in function of the context of the course: the more basic a course is, the

more overlap might be necessary between the instances of the two compared courses to accept them as equivalent.

Certainly at undergraduate level, programmes mostly take up some courses that have a general nature ("bildung"), for which similar courses could be accepted with far less than 90 % of match for the α parameter. Similarly, it is sometimes the usage to accept an even very low α value (but maybe with higher values than 70 % for the β value and maintaining also the context parameter threshold) for courses that substitute an elective course in a programme.

In the situation that A1 is part of a catalogue containing courses A1,…,An, out of which m<n are to be successfully completed (without loss of generality, we assume these to be A1…Am), the first three rules remain, the fourth rule is however changed.

In the "no-double-use" case: match(B.keywords,union(A2…Am)) <= γ

If the course B must be from the area of the catalogue, then additionally match(B.keywords,catalogue.keywords) >= β

Here, it is excluded that course B has the same content as one of the other courses taken from the catalogue.

The parameter γ shall have a value of 20%, but also here site-specific values are possible.

In the "union" case

Match(B.keywords,union(A2…Am) <= γ and match(B.keywords,union(Am+1…An)) >= β

Here, B must be a course from the area of the catalogue, and must match some courses from the catalogue that are not taken.

In the "one-by-one" case, there must exist one course Ai from A1,Am+1…An with

Match(B.keywords,Ai.keywords) >= β

Here, there must be one particular course from the catalogue that is not taken, against which B can be exchanged.

The different cases represent the different degrees of liberty that institutions allow when acknowledging courses, see Deliverable 9.1.

3. Course Metadata Supplied by Prospective Students

There are limited possibilities to improve reliability and rate of user input in the context of course exchange processes – but there still are some.

Comparison of course content *within* the CUBER system proceeds by means of a classification scheme derived from ACM/IEEE. The comparison of external courses will have to fit into this procedure. This solution is supported by the Dublin Core Metadata Initiative: ”Typically, a Subject will be expressed as keywords, key phrases or classification codes that describe a topic of the resource. *Recommended best practice is to select a value from a controlled vocabulary or formal classification scheme.”* (http://dublincore.org/documents/1999/07/02/dces/, page 3)

As students will not – and cannot – know the complete vocabulary of a complex classification scheme. The system has to help them to find out which terms are accepted and which are not. Self adapting input fields will be best practice for this purpose according to the state-of-the-art of HCI design. Thereby the object of adaptation has to be not only a single keyword but the whole path from the root to the respective class.

If the user types e.g. **Sim** in the sensitive input field,

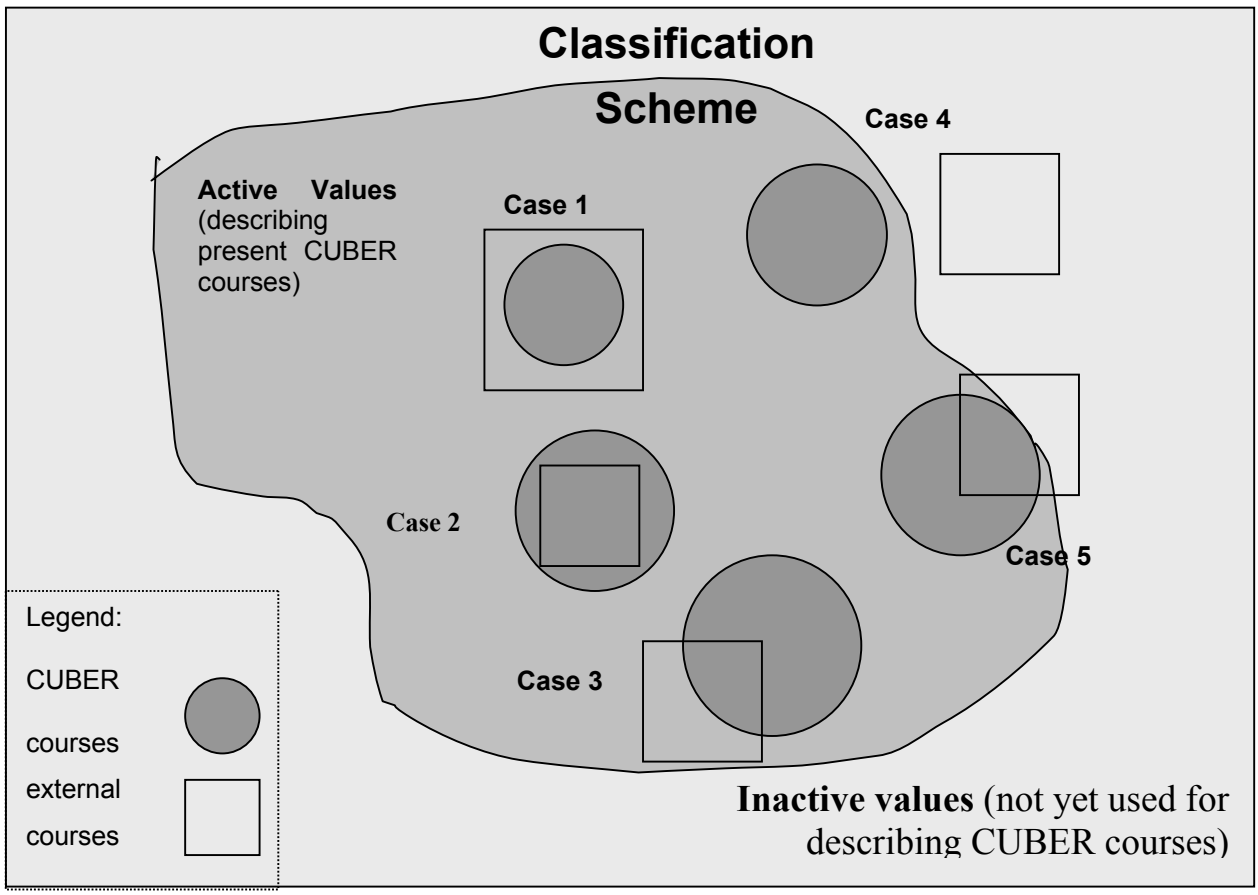
the system completes to ”**Simulation**” and offers all different options for the keyword ”**simulation**”, e.g. some examples from the ACM classification:

B. Hardware	B.1 Control Structures and Microprogram-ming	B.1.2 Control Structure Performance Analysis and Design Aids	*Simulation*
D. Software	D.4 Operating Systems	D.4.8 Performance	*Simulation*
I. Computing Methodologies	I.6 **Simulation** and Modelling		
I. Computing Methodologies	I.6 Simulation and Modelling	I.6.1 **Simulation** Theory	
I. Computing Methodologies	I.6 Simulation and Modelling	I.6.1 Simulation Theory	**Types of** *simulation*

The next step for the student is to select the appropriate one of all the options included in the system. In this way, users can select the valid values of a complex classification scheme without having to know – and understand! – the whole scheme in advance.

So far the users can choose *each* value of the whole classification scheme. Thus the keywords used to describe the external courses could as well be *inactive values*, i.e. keywords not (yet) used to describe CUBER courses.

Figure 1: Active *and* inactive values processed

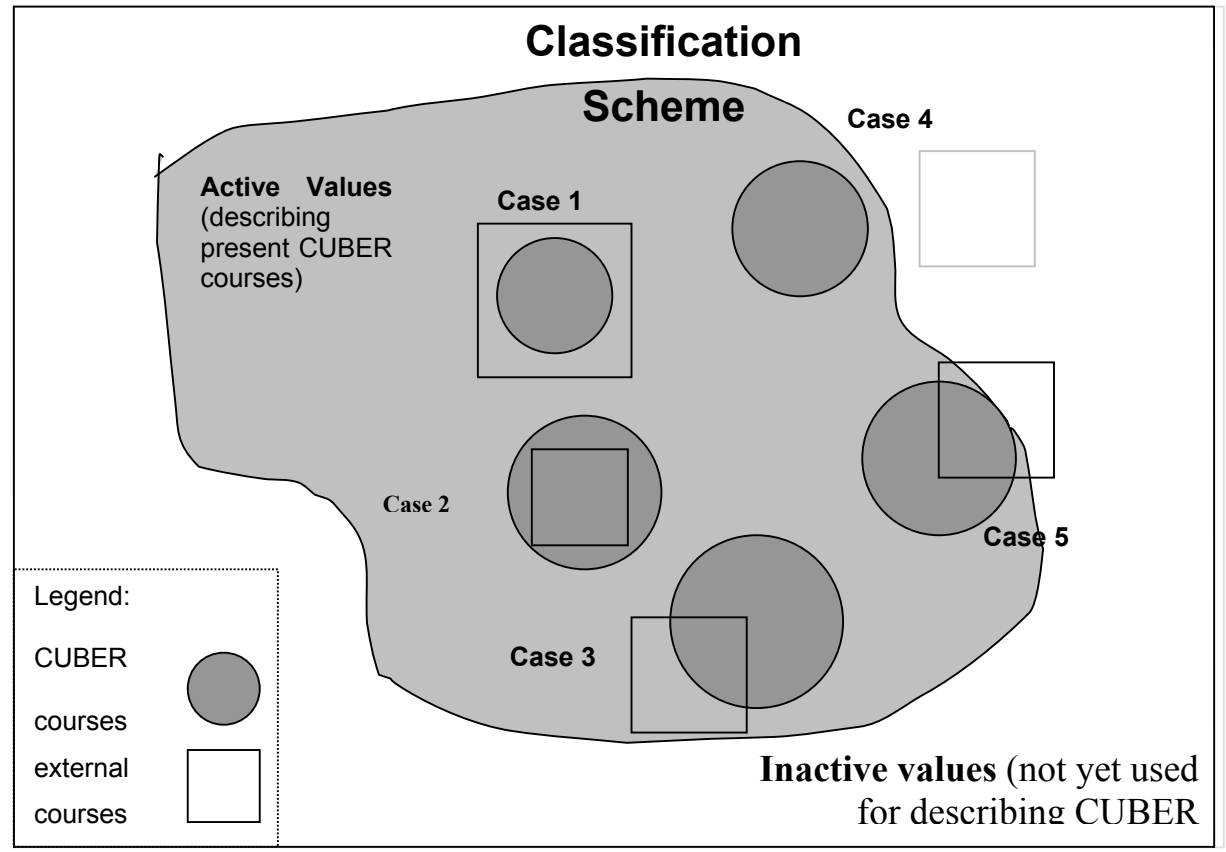


For the purpose of course matching, CUBER will only recognise and acknowledge *active values*, i.e. keywords already used for the description of CUBER course content (see cases 1 to 3 and case 5 in part). Consequently it will not make much sense to allow any vocabulary besides the active values – as it would be necessary for case 4 and particularly case 5.

The process can be speeded up if only active values are made self adapting and therewith visible to the users which will get immediate feedback about the lacking of a keyword in the system. As way out they will try or search for other keywords representing the content of the external course. And beyond it, they will quickly learn which keywords are not to be used for describing further courses.

The – particularly in the beginning of the existence of CUBER – much smaller set of keywords when disregarding *inactive values* is shown in figure 2. Under this presumption, case 4 needs not to be processed any more by the system. It is evident that there is no overlap of content, because there is not a single keyword describing the external course within the subset of *active values*.

Figure 2: Only *active* values processed



The strategies mentioned above will lead to the efficient use of appropriate *keywords.* But – since meaning is dependent on language and culture – it cannot be guaranteed that they will be used with the appropriate *meaning.* Each language area will generate different meanings of the same keyword or classification value. And beyond it, each culture (maybe even of a single university or department!) will generate different meanings. This is a general problem – in the same way affecting all information handled by the CUBER system. And this problem cannot be solved on the technical or design level.

Certainly while keywords should only be inserted in one single language to enable comparison, whereas the students are not necessary familiar with the used language. Ideally, a supplementary tool, translating the formal classification scheme from English into the mother tongue of the student could be added (use of a multilingual Lexical Database ?); but even then a fully error free input of data is not guaranteed.

Knowledge trees [see e.g.: http://ibis.nott.ac.uk/software/kt-available.html , **Brailsford, T.J., Davies, P.M.C., Scarborough, S.C., & Trewhella, W.J. (1997).** Knowledge Tree: Putting discourse into Computer Based Learning. *ALT-J* **5**(1) 19-26 or http://ibis.nott.ac.uk/software/kt97.pdf] could possibly be applied to reduce this problem. But knowledge trees are – on a technical level – much too complex to be integrated into CUBER. And – on the political level – at present too little accepted to be an instrument for achieving fast and reliable input of content for course exchange purposes.

4. Assessing the Reliability of User Supplied Data

The students entering data of their previous studies wishing to get them acknowledged, first by CUBER and then by their institution, may end up in entering incorrect data, no matter how honest and careful they attempt to be in this task. Therefore the system needs to check the data for its plausibility. Naturally, there are some preliminary constraints already in the input phase, that diminish the possibility for incorrect data. Such a constraint is, for example, the requirement to enter numerical data to the input field of ECTS Credits. However, the numbers themselves can be nonsensical in the context of a certain study element, e.g. by indicating to an extent of a study programme instead of a single course.

Each exchangeability criterion, each data element has its own plausibility constraints. Furthermore, the data elements together build a contextual framework for possible data values. To cover all the possible combinations of un/reliable data, the examination must cover first individual data elements and then them together with each other.

The decided exchangeability parameters in CUBER are the following:

- Content
- Extent
- Type of examination
- Difficulty level

As was stated in the WP9 deliverable D9.1 (Galindo et al. 2001) the CUBER Metadata schema contains sufficient elements to catch these parameters. The relative metadata elements for last two exchangeability **parameters Type of examination** and **Difficulty level** can easily be identified*: 5.15.2 CUBER.Educational.Assessment.Method* and *5.6 CUBER.Educational.Context*. Also, the equivalent metadata element for the parameter **Extent** has to *be 5.13 CUBER.Educational.ECTS Credits*, since that was decided to be the primary method in CUBER for indicating the typical learning time of the study element. Since the additional data *element 5.9 CUBER.Typical.Learning.Time* was allowed for local expressions of the extent, it has to be included as well. However, the first exchangeability parameter **Content** can not be described with a single metadata

element, but it requires at least two elements: *Subject* and *Discipline* from the metadata category *9 CUBER.Classification*. In addition, the content of the course can be measured from the general data, such as the description and keywords *(1.5 CUBER.General.Description and 1.6 CUBER.General.Keywords*) – though more equivocally because of the data type (free vocabulary). Therefore the user has to be asked to enter quite a lot of data for getting a acknowledgement suggestion from the CUBER system for previous studies.

Following the guidelines described in chapter 2, the data to be requested from the user would be the following:

- Description
- Keywords
- ECTS Credits
- Typical Learning Time
- Discipline
- Subject
- Difficulty Level
- Assessment Method

For the plausibility checking an additional data element of the study object needs to be expressed:

- Aggregation level

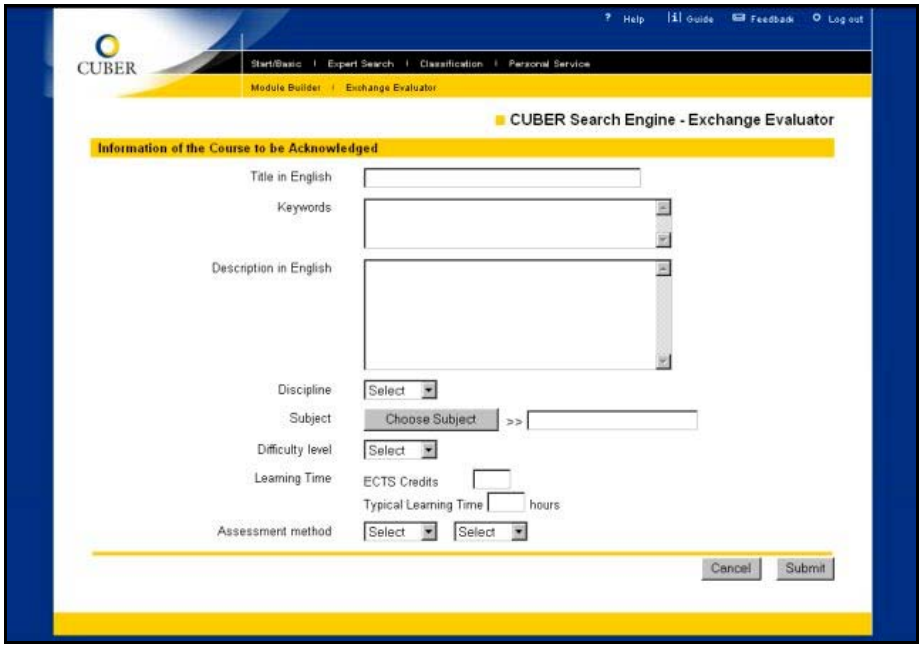


Figure 4.1: Data requested from the user – draft screen layout

The plausibility of these data elements will next be examined from the viewpoint of the stated exchangeability criteria and in correlation to each other.

4.1 Aggregation level

CUBER distinguishes studies in four aggregation levels: material, course, package, and programme. The scope of exchanging studies is naturally within the upper levels, namely package and programme. The acknowledgement would concern minor study elements building either a package or a programme, whereas packages and programmes themselves can not be considered to be acknowledged as whole. Materials, on the other hand, are seen as study elements serving information source for courses, and thus considered dependent of them. Therefore materials can not be seen relevant for the acknowledgement procedure. Finally, a course, being the lowest level offering credits and recognition, is the only aggregation level that can be accepted for the exchange procedure.

The default for the aggregation level is *Course.* This affects greatly the plausibility of other criteria. Therefore the student should be informed that other aggregation levels can not be compared with CUBER.

4.2 Description

When writing the description of a course, the student has to find the original description of the providing institution or compose the description by him/herself. This alone diminishes the feasibility to evaluate the reliability of the data. Furthermore, being free format text in human language, the data itself is difficult to be automatically evaluated. Though the system could pick terms recognised by the Lexical Database and compare these to the given keyword parameters, the equivalence could still be vague. A student writing the description of a study course might use different terms for the same phenomena as the person determining the acknowledgement keywords, or use the same terms with a different meaning. Thus, the risk of divergent interpretations is considerable. In spite of that, the description can be seen valuable for reliability checking, since it can be used for excluding undesirable combinations. The institution could have a list of keywords which should not be allowed from a course to be exchanged, or the system could automatically use other criteria as such 'not-allowed' keywords. A simple example could be the comparison of difficulty: if a course description has words 'introduction', 'basics' or 'elementary', it could hardly be considered equivalent to courses of difficulty level 'Advanced' or 'Post-graduate' – unless the topic of the basic knowledge was very demanding. This example proves that a textual presentation using human language is always loaded with semantics.

All in all, assessing the reliability of the description requires intelligence in such an amount that it would best be done by the human reading the text and not the system comparing the data.

4.3 Keywords

The keyword data resembles the description data, because the format is free text and the student could pick suitable terms from the provider's information or invent them him/herself. In spite of being free for the student to enter, the keywords would be easier to prove reliable/unreliable, since the semantics of the language would be diminished to individual terms in stead of full sentences. Firstly, the system could offer keywords from the Lexical Database, which would later make the evaluation easier because of the common vocabulary (assuming that content providers would use the same method for finding their keywords). Secondly, the Lexical Database could be used for checking the spelling of the term, in order to prevent accidental typing errors which would affect the final comparison of data.

The keywords could also be compared to the classification data entered by the student. If the keywords covered too wide a range of science when compared to the Subject and Discipline of the course, the system could claim the data too general to be exchangeable.

Also the number of keywords can be considered relevant: a real comparison could not be made with, for example, less than three keywords.

4.4 ECTS Credits

The primary data describing the extent of the studies is ECTS Credit. The input allows only numerical data, and therefore the possible options are already in a limited range.

The extent of studies must correlate with the aggregation level: a course scarcely lasts more than one semester, which usually credits 30 ECTS points. Therefore an entry of more than 30 ECTS Credits could be alerted. Since there are national and local conventions in this, the maximum number of credits per a course could also be smaller.

Also the minimum could be established: a course less than one ECTS Credits could be considered not exchangeable altogether. Naturally, institutions could have their own thresholds here, but at least a value zero could be a mere mistake and thus rejected.

4.5 Typical Learning Time

The Typical Learning Time is offered only as a means to express national and local conventions for the extent of studies. The data type is, again, numbers and the default unit for this data is hours. Since there is a recommendation (a standard) for calculating the ECTS Credits to study hours (or vice versa), this recommendation should be used for checking the plausibility between these data. One ECTS Credit usually stands for 40 hours of student's work, and then an entry of 2 ECTS Credits but 10 hours could be claimed uneven.

4.6 Discipline

The CUBER system uses its own classification for determining the field of science for each study element. The Discipline should be selected according to the organising institution or the target group, whereas the topics of the course should be expressed with the element Subject. Together, these two classifications express the contents of the course, and distinguish its taxonomic character. For example, a course of Subject "Internet > Security > Authentication" in Discipline "Engineering & Economy > Technology > Transport engineering" is surely different from the course of the same subject in Discipline "ICT & Computer Science > Human-Computer Interaction".

Though these data elements are the most reliable means for evaluating the contents of the course, the student may not be aware of the importance of making the correct choice or even not able to make the correct choice with such a deep and detailed selection (which was also described in chapter 3). Therefore the plausibility check can not too strongly emphasise these data, but some interpretations can be made.

As mentioned, the Discipline should express the field of the providing institution or the prospective target group of students. If these data were not entered by the student, the Discipline can not be verified reliable or not. It might be worthwhile comparing the name of the institution to the vocabulary of the chosen Discipline categories, but as it was with description vocabularies, there is always the risk of misinterpreting the terms.

4.7 Subject

The data element Subject expresses the classification category/ies of the course. In the field of ICT, the Subject classification could be compared to the used keywords, because in the Lexical Database the ICT terminology is attached to the Subject classification: each term belongs to one or more Subject categories. Therefore the reliability of the Keyword-Subject match could be made, for example, in the following

way: If a keyword found from the Lexical Database would not match with the subject category, the user could be given a notice of this mis-match. Also an option to accept the mis-match should be offered, because it might be a insufficiency of the Lexical Database.

A more implausible combination for a single course is a set of keywords from more than, for example, five Subject categories. Such a finding could be announced to the student as a hindrance to effective course comparison.

4.8 Difficulty Level

The difficulty of a study element can be chosen from six options. A selection of only few options can be difficult for the student to choose from – especially because of the obvious importance of the choice – unless the providing institution has offered the information in similar scale. The system can compare the chosen value to the vocabulary entered in other fields, as explained before in chapter 4.2, and thus evaluate the plausibility. Yet, the true reliability of this data must be evaluated by a human by comparing it to the Description, having the Discipline and Subject in mind.

4.9 Assessment Method

The Assessment Method is also chosen from the list of offered vocabulary. There are several options of which others are under category 'Attendance required' and others under 'No attendance required'. Because the assessment of a single course can be based on several examinations, tests or other methods, there must be an option for multiple values for this data element. However, only two or three can be seen of primary importance for the course comparison. This limitation should be set within the interface, and then the reliability of this data would be already improved. The only option requiring a notification is 'Undefined method', because most probably acknowledgement can not be based on such an assessment – or at least it might diminish student's possibilities to get the course acknowledged.

5. Evaluation of Exchange Algorithm - Best Practice

In order to verify that the exchange algorithm really meets its specification, i.e. in order to check that its recommendations match the decision of the participating institutions frequently enough, an evaluation was undertaken. The evaluation was restricted to the basic scenario that a mandatory course is to be replaced. The reasons for this restriction are twofold. First, the scenario with a course from a catalogue only relaxes the basic scenario, and thus the basic scenario is "harder" to test. Second, the amount of work necessary to do a meaningful evaluation over all scenarios would have been too much for the short time period available.

The evaluation was undertaken by FernUniversität Hagen and Universidad Oberta de Catalunya, Barcelona. Each site selected a set of courses which was appropriate in the sense that some courses matched very closely and others were candidates for rejection. This was achieved by a proposal from Hagen which was then matched by Barcelona. A set of 3 courses were thought appropriate, when carefully chosen, qualitative analysis can provide as good validation as evaluation that is based on a quantitatively larger sample.

Now, each site tested whether the other site's courses would be acknowledged as substitutions for its own courses by the exchange algorithm and by the institution's decision. Thus, a two-sided evaluation was achieved.

The courses chosen by FernUniversität were:

1. Math for Computer Scientists I (Linear Algebra)
2. Introduction to Imperative Programming
3. Software Engineering I

The first and third courses have 8 ECTS, the second course has 4 ECTS. The first two are undergraduate, the last is a graduate course. The examination method in all three is continuous evaluation (by assignments) plus an exam.

The courses chosen by Universidad Oberta de Catalunya were:

1. Algebra
2. Basis of Programming
3. Software Engineering I + II

The courses have 5.2, 6.5, and 10.4 ECTS respectively (converted from Spanish national credits), the first two are undergraduate, the last is a graduate course. The

examination method in all three is continuous evaluation (by assignments) plus an exam.

The decision of FernUniversität was:

1. An acknowledgement is not allowed due to insufficient extent of the Spanish course.
2. An acknowledgement is allowed because extent of the Spanish course is sufficient, the examination methods and Context (difficulty) are identical and the contents match sufficiently.
3. An acknowledgement is allowed because extent of the Spanish course is sufficient, the examination methods and Context (difficulty) are identical and the contents match sufficiently.

For all three courses, the decisions of the CUBER exchange algorithm and the decision of the Computer Science Department at FernUniversität matched.

Due to the lack of the authoring interface, no real metadata information was available. This posed no problem for extent, difficulty, and exam, as these could be retrieved in a straightforward way. The content description in keywords had to be retrieved manually from freetext descriptions of the courses. For the first two courses, this posed no problem. However, for Software Engineering, the context match was problematic, as the UOC course treats more advanced subjects than the Hagen course. Still, the course should be acknowledged. The consequences from this observation will be discussed later in this section.

The decision of Universidad Oberta de Catalunya was:

1. Algebra: the substitution is allowed.
2. Basis of Programming: the substitution is not allowed because the extent of the German course is not sufficient and the contents do not match sufficiently.
3. Software Engineering I + II: the substitution is not allowed because the extent of the German course is not sufficient.

Here the case occurred that the content match result differed (for Programming) depending on the institution. This is however not surprising as the result is relative to the institution's own course. As UOC's course has 6.5 ECTS credits, and FEU's course only has 4 ECTS credits, the content match from FEU's perspective is high, while the "small" course can only match a small part of UOC's course's content. The difficulty for the Software Engineering courses was already discussed with the FEU decision.

The results of the evaluation reveal that the exchange algorithm is mostly matching the institutional decisions. However, care has to be taken with the content description. This lead to an investigation how the content could be described so that keywords are consistently used, to enable comparison and exchangeability of courses of different

providers. The underlying theme is how to make the keyword choice as independent as possible from the operator using the author interface.

The following proposal was derived:

In addition to keywords, a classification scheme could be used, such as ACM or IEEE classification. The classification can be used as a first filter in the sense that if the classifications of courses do not match, then their contents will not match. If their classifications match, then the keywords are used to compare course contents.

The keywords should be used in a consistent manner. In order to achieve this, an online help could be provided by the authoring interface. This online help might give the author hints in the sense of “Other courses with the same classification used the following keywords” and/or use the lexical database to warn the author if he introduces new keywords. In this sense, the set of keywords could be used consistently and in a self-adapting manner which is necessary for maintainability.

6. Evaluation of ECTS Implementation at UOC

6.1 Introduction

The aim of this section is to provide the information required when considering the establishment of **European Credit Transfer System** ("ECTS") criteria at the *Universitat Oberta de Catalunya* (the Open University of Catalonia, "UOC"). It also introduces matters that must be considered for its adoption at institutional level.

To be able to carry out a detailed study of the impact of implementing the ECTS at the UOC, account should first be taken of the unique characteristics of the new educational concept represented by the university.

The **UOC** has a university education concept based on the intensive use of new technologies with a learning model which allows students **lifelong** access to knowledge. By means of its **Virtual Campus**, they access a totally **personalised educational process**.

Its main objective is to facilitate learning, and students are at the centre of the university's teaching activities. It is thus a customer-oriented university (in terms of both individual and collective customers). Departments, curricula and projects are designed in accordance with their real-world needs.

It is in contact with **knowledge networks** at an international level and provides education around the world in a number of different languages. Use of new information technologies allows the UOC to be highly active in the creation of alliances, with numerous co-operation networks, collaboration agreements for shared qualifications, etc.

One example of the specific nature of its world-wide interchanges is the **Metacampus** project. This is an academic co-operation system which makes possible the virtual interchange of content, teaching staff and subjects between universities across the world.

The **European Community** promotes co-operation between universities in the aim of increasing the competitiveness of the European higher education system, and as the result of a study of the need for higher education to react to a new environment marked by globalisation, information and communication technologies, increasing competitiveness and an emerging process of commercialisation of university courses.

One of the initiatives taken in this field was the signing of the **Bologna Declaration**[1], by the Ministers of Education of the vast majority of European countries. This promotes the convergence of different systems in the aim of improving the transparency and compatibility of different courses, degrees and diplomas.

[1] The European Higher Education Area. Joint declaration of the European Ministers of Education Convened in Bologna on the 19th of June 1999.

According to the Bologna Declaration, the keys to greater consistency and compatibility between courses in different education systems are:

1. The adoption of a system of easily readable and comparable **degrees**, also through the implementation of a Diploma Supplement.
2. Adoption of a system essentially based on **two** main **cycles**, undergraduate and graduate. The degree awarded after the first cycle shall also be relevant to the European labour market as an appropriate level of qualification. The second cycle should lead to the master and/or doctorate degree.
3. Establishment of a system of credits - such as in the ECTS system - as a proper means of promoting the most widespread student mobility. Credits could also be acquired in non-higher education contexts, including lifelong learning.
4. Promotion of European co-operation in **quality assurance** with a view to developing comparable criteria and methodologies.
5. Promotion of the necessary European dimension in higher education, particularly with regards to **curricular development**.
6. **Promotion of mobility** by overcoming obstacles to the effective exercise of free movement of students, teaching and administrative staff of European universities and other higher education institutions.

Work is being carried out, at different levels, to achieve these goals in the vast majority of EU countries, so as to construct a **"European Area of Higher Education"** before 2010.

The principal objective of the ECTS is to consolidate a transferable and accumulable assessment system which reflects the work a student has to carry out to achieve an academic qualification.

6.2 Principal characteristics of the ECTS

The aim of the ECTS is to become an instrument which helps achieve transparency by establishing the conditions required to bring closer together different centres by facilitating the recognition of academic results. The use of assessment systems which can be understood by everyone –credits and grades– and which allow for a better understanding of national higher education systems, constitutes a practical method of guaranteeing transparency and facilitating their recognition.

A. The ECTS credit

Different countries require a different level of adaptation to implement the ECTS, depending upon their individual education systems and, more specifically, on the possible prior existence of a national credit system. Assignation methods can range from a simple mathematical adjustment to an important conceptual change. The principles are as follows:

ECTS credits represent the **student workload** on a relative, not absolute basis. They indicate the workload required to successful complete each course unit.

In the ECTS, **60 credits** represent the workload of **an academic year** of fulltime study (for the average student) and 30 credits that of a semester[2]. One credit thus represents one-sixtieth of the student's workload for an entire academic year. On the basis of this general outline, the following information can be extrapolated to provide us with assessment tools[3]:

The estimated amount of time for a fulltime workload for one academic year, on the basis of the academic year's **40 weeks** of **40 hours each**, is **1,600 hours**. Each credit therefore require an average of **25-30 hours' work**[4].

Once the time value of each credit has been standardised, we need to calculate **the time spent by the student on each subject** (which well depend of the complexity and length thereof). In formal higher education, this will include class contact time, the number of pages of material provided, the student's own research, exams, etc.

Two systems are generally employed to allocate credits in formal higher education systems:

a. The "bottom up" approach: Here, the course unit is the central focus of attention. No attempt is made to link the unit with the curriculum (or degree) as a whole. This approach reflects the workload a student must undertake to complete a subject (course unit).

b. The "top down" approach: Here, the curriculum (or degree) as a whole is the starting point. The credit value of each unit is linked to two levels: 1) the degree and 2) the academic year studied. This guarantees a fair distribution of credits (and hence the student workload) amongst a degree's different courses.

Bearing in mind that, in Spain, the **national credit** in attendance-learning universities is based on contact hours (classroom, laboratory and academically-directed complementary work) and the **ECTS credits** on the real student workload, adoption of the new system would require a significant conceptual shift. There is a similar situation in Germany, where contact hours are the national credit and to shift to ECTS, subject specific conversion tables have been very helpful, at least as guidelines, because courses related to one subject tend to have similar conversion rates.

Under no circumstances can implementation arise from a mere mathematical translation of the current system (based, as we have said, on contact hours) to reach the **European**

---

2 Student workload is not identical all study years and study programmes, it is not completely true in practice.

3 This may vary in accordance with each country's average working week and its academic timetable.

4 La armonización europea de las enseñanzas de la reunión de la comisión sectorial de secretarios generales de la CRUE. Carmen Ruiz-Rivas Hernando, Valencia, 10-11 May 2001

credit, since such an approach would involve no conceptual change in the value of the credit. Far-reaching research is required to explain clearly what results are expected of students and what effort is required to achieve the objectives or requirements for obtaining a specific qualification.

B. **The ECTS grading scale**

The aim is to achieve a common unit to assess the quality of academic results, since these can be interpreted differently from country to country or even from one institution to another.

During the first ECTS pilot stage, these grades were determined by means of a percentage comparison of students studying the same subject (for example, an A grade was given to the 10% of students with the highest marks). Currently, however, the trend is towards greater precision, with numerical grades out of ten and grades to one decimal point. This system requires:

A) The introduction of numerical grades to one decimal point
B) The calculation of the relative percentage for each group

These numerical qualifications would be complemented by adding the normalised ECTS grading scale and the reference to percentages per group.

ECTS grade	*Approx. percentage of successful students normally achieving the grade*	**Definition**
A	10	EXCELLENT - outstanding performance with only minor errors.
B	25	VERY GOOD - above the average standard but with some errors.
C	30	GOOD - generally sound work with a number of notable errors.
D	25	SATISFACTORY – fair but with significant shortcomings.
E	10	SUFFICIENT - performance meets the minimum criteria.
FX	—	FAIL - some more work required before the credit can be awarded.
F	—	FAIL - considerable further work is required.

This represents information which is complementary to the grades given to students and **does not substitute local grades**.

The idea is that the grades awarded to students can be understood in any EU country. The use of this grading system is considered indispensable for inserting this information in the **Diploma Supplement**[5].

6.3 The current state of implementation of the ECTS

The ECTS was originally tested within the **Erasmus/Socrates** programme as a means of facilitating the academic recognition of studies abroad.

Currently, it is considered necessary to go further, to resolve not only problems of mobility in European programmes but also the need to establish and create a **common framework** to favour recognition and understanding of different university degrees and qualifications[6].

Some European countries have already modified their national credit systems, which covered different types of education, to adapt them to the ECTS. For others, the ECTS is their first experience of credits.

In the case of Spain, the system for **transferring** credits is different from that of **accumulating** them. The majority of Spanish universities (but not the UOC) apply, in parallel, two credit systems:

a. ***The ECTS*:** used peripherally and solely for exchange students.

b. ***The national credit system*:** this is a key cumulative element for the calculation of credits, and is what allows students to receive their official qualifications. The distribution of credits is established in Spanish legislation[7].

Retaining this double system of credits is possible but costly and operationally inefficient for universities. It would be desirable to use the same type of credits for the purposes of both transfer and accumulation. **Total convergence between the two systems** would require a change in existing legislation on the structure of qualifications and on the concept of the credit. At the very least, it is dependent upon a political

[5] A supplement to the academic qualification or certificate which will include all the details of the student and the qualification studied, making reference to the subjects and their ECTS credits and grades. A computer model is being developed which will allow for the complete record to be reproduced and translated into another language. http://gia1.di.uminho.pt/dsdt

[6] The idea is to promote two kinds of mobility: horizontal mobility, where students based at one university study for a limited period of time at another, and vertical mobility, where, after attaining a certain level, students join another institution to achieve a subsequent level.

[7] This legislation establishes some general guidelines for the different official university qualifications, so that they may be recognised throughout Spain. A credit is defined as a cumulative unit which takes into account classroom time (theoretical and/or practical classes) but never students' work.

decision[8] to officially implement the ECTS in the country as well as the criteria and rules for adapting the current system.

The extent and implementation of the credit system requires a conceptual reorganisation of educational system, to adapt it to new models of **lifelong learning**. This changes the initial meaning of the credit as an established and easily-transferable asset by adding a further factor, that of accumulation through different educational stages. Within the context of lifelong learning, these stages include the fields of **formal**, **non-formal** and **informal education**[9].

At a European level, initiatives are currently being promoted between different sectors and levels to achieve the transformation of the ECTS into a cumulative credit system which can include adult education, vocational and/or professional training and lifelong learning, to make it a kind of **"credit melting pot"** which will link all levels of training and education. It is here where concepts such as the **life of the credit** and how **to link credits** from different stages of education become important (for bridge-building between qualifications).

The EU is currently carrying out pilot programmes[10] to introduce and adapt the ECTS to a more global learning dimension and also viability studies on **extending the ECTS** to promote lifelong learning and to record informal and/or prior learning[11]. Learning can also be acquired outside of teaching centres and there is a need to create rigorous systems that accredit and measure this in all its different forms.

These programmes and studies start on the basis of the core principles of the ECTS which are currently being implemented in formal higher education environments. The aim of this analysis is to create guidelines for awarding credits for subjects outside of full-time and attendance-based learning environments. The goal is to achieve new ways of allocating credits to respond to the needs of more flexible, intensive, half-day or

---

[8] In its proposed new University Reform Act (LOU, in its Spanish initials), the Spanish government declares that it will take the steps required to form part of the European Area of Higher Education.

[9] Formal education: that which takes place at teaching and training centres and which leads to recognised diplomas and qualifications. Non-formal education: that which takes place outside principal education and training structures and which does not normally lead to official qualifications. Non-formal education may be obtained at the workplace, as part of activities run by civil organisations or groups (youth groups, trades union, political parties, etc.). It may also be provided by organisations or services established to complement formal systems (art, music or sports classes or private exam "crammer" courses. Informal education: that which occurs in everyday life. Unlike the previous two forms, it cannot be recognised, even by the individuals concerned, as a contribution to their knowledge or competences.

[10] By the end of 2002 the European Commission will develop a "portfolio" system which will allow people, at all stages of their education and training, to collate and present their qualifications and skills. By 2003, a modular grade accumulation system will be developed from the ECTS which will allow for the combination of education and training received in different centres and countries. This will be a form of bridge-building between qualifications within the framework of lifelong learning.

[11] Thematic Group THEG6- Accreditation & ECTS: *Accreditation of Prior Experiential Learning* (APEL);

distance course. Guidelines on the allocation of credits will be made available in the future, with studies on assessing all forms of learning.

6.4 Credits at the UOC

In the case of the **UOC's official courses** as in those of in the rest of the country, one credit is equivalent to **ten class hours**. Currently, **credits** for the UOC's different courses are awarded in line with Spanish regulations.

In accordance with the UOC's teaching model, the **value of a credit** is deemed to be ten hours of leaning class time (as indicated in the course plan) and five hours more for assimilating their content.

Although its course plans and different curricula have a minimum duration in terms of semesters, the flexibility of the UOC's academic regulations allows students to take advantage of a wide range of possibilities when deciding upon the number of credits for which they wish to matriculate each semester and the subjects in which they matriculate. Students can adjust their workload to take into account the amount of time they have available.

The UOC's official qualifications contemplate the possibility of partial academic certificates **(progressive graduation)**, in accordance with pre-established itineraries bringing together a group of subjects. This system of progressive graduation, which is clearly linked to the requirements of the labour market, gives rise to a study system which runs parallel to the official course plan. Individual students can organise their approved studies as they see fit, always under the guidance of a member of teaching staff.

The UOC's **assessment system** is one of the key elements in its methodology, as regards not only official studies but also postgraduate and university extension courses, as it permits progressive monitoring by both students and teaching staff. It allows students to control their own progress and to study at their own rhythm.

To obtain the **final grade** for a subject or course, the grade obtained from the final exam is crossed, by means of a set of standard formulas, with that arising from the continuous assessment process (when the latter has been successfully completed). **Continuous assessment** is the range of activities, practical work, exercises, assignments and debates which are carried out and assessed continuously by teaching staff. The purpose of **final assessment** is to evaluate on an integrated, global basis the knowledge acquired as part of the course or subject.

6.5 The impact of implementing the ECTS at the UOC

Bearing in mind that, at the UOC, students are at the centre of teaching activity and that the principal objective is **to foster learning**, changing the concept of the credit to bring it into line with the ECTS will not require a change in philosophy, as may be the case at other universities.

Implementation could be tackled in two stages. In Stage One, certain important decisions need to be taken, whilst Stage Two would be one of implementation.

Stage One:

A. When to implement the ECTS?

To answer this question, three important matters should be borne in mind:

1. That the implementation of an ECTS credit system before legislative change at a Spanish level[12] would lead to the parallel running of two credit systems (the national system and the ECTS, at least in the case of official qualifications).
2. That new Spanish legislation will define the exact nature and structure of the rules governing the credit system. On the basis of this, each centre will have to implement their own reforms.
3. That the findings of the pilot scheme currently underway will propose mechanisms –examples of good practices– for the awarding of credits in more flexible education contexts, non-full time study, distance learning, etc.

B. Who should be involved?

The formation of a multidisciplinary technical group is recommended, made up of those who should be most directly involved in the process.

Those making up group should come from the following areas: departmental teaching staff, a specialist in grading, a specialist in Credit Transfer System, a specialist in campus information, a computer specialist, an expert in the legal framework for recognition and agreements. Team members should work together and involve others who make the contributions required at different times during the project.

Generally speaking, the group's work should cover the following areas:

a) Definition of the professional profiles and social needs of the courses and the desired academic results in terms of the required abilities and competences

[12] To implement the new degree structure (adoption of a system based on two cycles) and the new credit system. The first, undergraduate, qualification, which allows graduates to carry on certain professions, could include the current qualifications of Diploma, Technical Engineer and the duly harmonised first cycles of Bachelors and Engineering degrees (180-240 ECTS credits). The second qualification would be postgraduate in nature. (La Declaració de Bolònia i la seva repercusió en les estructures de les titulacions. D. DoCampo. September 2001)

b) The development of mechanisms for measuring the workload of different subjects
c) Ensuring the transparency of different interchange agreements
d) Overseeing the criteria and procedures for recognising transferred credits
e) Incorporation of percentages in groups to determine ECTS grades.

C. At what speed could implementation take place?

A pilot scheme could be organised, allowing for implementation in a particular educational area (recognised qualifications, for example). Once this first phase has been completed, the ECTS could be implemented in all UOC departments[13].

Phase Two: Development

A. Information and awareness raising at the UOC

This covers what the Bologna declaration is, and what the creation of a European Area of Higher Education means for the future of the European university system. It is important to present the ECTS as part of the general process of European convergence.

Tools for this could include:

a) Simple informational documents
b) Fostering debate on convergence
c) Inviting specialists on the subject to the university (such as a National ECTS Counsellor[14]).

B. Evaluation of content and academic competences: The change in the credit system should encourage internal debate on better definition of **educational objectives** and a review of subject curricula. Definition of **professional profiles** and **social needs** and the provision of useful products in terms of knowledge, abilities and competences[15].

C. External relations: It is important to establish links with those outside the university, such as ECTS Counsellors, European pilot projects, the Ministry of Education, Spain's Rectors' Council, etc., and to keep up to date with innovations in the field which may be of use in the changes.

---

[13] The remaining university courses (own degrees, postgraduate education, doctorate, open summer university), pre-university courses, university extension courses, business training, etc.

[14] ECTS Counsellors: http://europa.eu.int/comm/education/socrates/ectscons.pdf

[15] A pilot scheme named "Tuning Educational Structures in Europe" is currently being carried out and acts as a forum for discussion between five disciplines (Mathematics, Geology, Business Studies, History and Education Sciences) to foster convergence by developing a structural curricular model for each subject to aid recognition and integration of degrees at a European level. Work is also underway on creating a common methodology for measuring student workload. (Completion of the project is planned for June 2002) http://europa.eu.int/comm/education/tuning.html

D. The allocation of ECTS credits: Having reviewed the definition of professional profiles and desired academic results, there is a need to know whether the work students carry out is in line with these parameters. A decision must be made on the method of measuring the student workload and the method for allocation ECTS credits to UOC courses.

The UOC's communication systems permit the involvement of students in the process of measuring the workload of a specific subject, although, at other universities, it is only the teaching staff who do this on the basis of the difficulty and volume of the subject. Nevertheless, students can be a direct, valuable source of information for adapting curricula or course plans to the educational expectations of a specific academic curriculum (educational objectives).

To this end, a pilot scheme could be organised in which students respond to **a workload evaluation questionnaire** after passing a subject. This would be a useful tool for establishing the average student workload for a specific subject. To understand the time a student spends in mastering a subject, account should be taken of factors such as:

1) Time connected to the campus (forum, debates, e-mail)
2) Background reading
3) Exam preparation
4) Sitting of exams and face-to-face encounters
5) The performance of practical assignments, etc.

*Of the credit allocation methods discussed above, the **"bottom-up" approach** allows for the disassociation of course units from overall curricula and thus can be used more flexibly. This could provide a better response to the UOC's needs, since its students who structure their studies and develop their curricular itinerary. Additionally, the **"top-down" system** is more complex and may provide less flexibility.*

All of this, the use of the bottom up approach would suppose the fitting of the different courses to the total number of credits. This issue would suppose a fitting in the number of courses offer.

An example of ECTS credit allocation at the UOC
Using the example contained in the Appendix, the calculation of the student workload implied by a subject from an approved UOC course plan is as follows.

Course content	**Workload**	**ECTS credits (25-30 h ≈ 1 ECTS)**
Participation in professor's bulletin board	2 h x 15 weeks = 30 hours	1.0 credit
Paper reading material: 4 modules (250 pages)	6 pages per h = 55 hours	2.0 credits
Performance of 6 practical assignments (3 hours per week)	2 h x 15 weeks = 30 h	2.0 credits
Background reading for the 6 practical assignments	6 assignments x 25 pages each = 150 pages, @ 6 pages per hour = 25 h	1 credit
Face-to-face encounters and exam	4 hours	0.2 credits
Participation in forum and debate	6 hours	0.3 credits
Total	**150 hours**	**5 ECTS credits**

Suggestion: To avoid multiple rounding errors during conversion, one should first add up the hours and then convert to credits. Only integral values of credits should be assigned

E. Grading system

To integrate the ECTS grading and credit system (which does not replace the UOC's own system, but rather complements it), the UOC student assessment system needs to incorporate the relative percentage approach to compare each member of a group of students studying the same subject against each other.

Academic certificates will have to display the results obtained by students clearly and comprehensibly. We recommend monitoring the development of the **Diploma Supplement**[16], which is currently undergoing trials.

F. Transparency of information

The ECTS credit and the grade must be complemented with complete, up-to-date information on courses. This is especially important for two reasons:

A. For decision-making in the recognition of outside studies
B. To establish agreements with other institutions in the future (shared curricula, exchanges, etc.)

[16] Via the CRUE (*Conferencia de rectores de las universidades españolas*, Spanish universities rectors' conference): http://www.crue.org/

The EU recommends providing the same information to both potential future students and those already studying at an institution. This must include all relevant details concerning the credit system utilised (for both transfer and accumulation purposes).

Other information aiding transparency in exchanges includes[17]:
a) Complete information on course subjects, including credits, objectives, the level of the course and the required workload;
b) the structure of the course;
c) assessment criteria in relation to objectives;
d) language;
e) recognition procedures;
f) Information on the institution, methodology, computer requirements, etc.;
g) contact persons for establishing agreements.

An important aspect of the accumulation of credits as part of lifelong learning is the provision of information, as far as is possible, on recognition criteria (within a context of vertical mobility). Students might see the ECTS as providing them with complete freedom to combine credits from different course units and levels.

6.6 Conclusions

The principal factors to be considered when implementing the ECTS are summarised below:

A) Favourable factors

- The concept of credits based on students' workload is more in line with the UOC's teaching system than that of credits based on class time.
- The system encourages the assessment of the quality of institutions based more on education system outputs (knowledge and skills acquired) rather than inputs (teaching, course curricula, etc).
- The system has been designed for application in all possible types of learning rhythms: full time, part time, intensive, etc. Future results could contribute interesting tools for the UOC, specifically in the field of transferring and accumulating lifelong learning credits[18].

[17] As part of the Socrates exchange scheme, an information package was established, which provided the information required on courses and the institution in question.

[18]: http://europa.eu.int/comm/education/socrates/download.html

- The European credit could become a useful tool for students when deciding how many credits to matriculate for on the basis of the time they have available.

- The allocation of the new credits (and new qualifications in the future) may encourage internal debate on the different courses offered (content, size, professional objectives, etc.).

B) Obstacles:

- Implementation now would lead to the parallel running of two credit systems (one Spanish, the other ECTS), at least in the case of official qualifications.

- Currently, there is no specific methodology for measuring student workload within a context of lifelong learning.

- The European grading scale is not considered fully defined, and its implementation during the pilot stage was not particularly widespread.

- Provided there is no prior agreement, there is a need to encourage the freedom of universities in the final recognition of studies at other institutions. There is a need to detect the potential damage that the "à la carte" accumulation of credits by students may cause to the composition of their curricula.

7. Works consulted

- Brailsford, T.J., Davies, P.M.C., Scarborough, S.C., & Trewhella, W.J. (1997). Knowledge Tree: Putting discourse into Computer Based Learning. *ALT-J* **5**(1) 19-26 or
  http://ibis.nott.ac.uk/software/kt97.pdf
  http://dublincore.org/documents/1999/07/02/dces/, page 3
  http://ibis.nott.ac.uk/software/kt-available.html

- Galindo, E., Kautonen, H., Keller, J. 2001 *Intermediate Report Including Revision of Meta Data.* Internal deliverable D9.1. CUBER. <http://bscw.cuber.net/bscw/bscw.cgi/d43953/D9-1.doc>

- LOU-*Llei Orgànica d'Universitats* (University Reform Act) of 26 December 2001
- Conference Report of International Seminar Leira, Portugal -Credit Accumulation and Transfer Systems- November 2000
- http://europa.eu.int/pol/educ/index.htm
- Discussion paper: Workload and the Calculation on ECTS Credit Points (Robert Wagenaar –University of Groningen-)

- http://www.enic-naric.net/index.asp

- Trends in Learning Structures in Higher Education (I). Inge Knudsen. June 1999

- Trends in Learning Structures in Higher Education (II) Guy Haug and Christian Tauch. April 2001

- Declaración de Bologna: Adaptación del sistema educativo español a sus directrices. Estudio Comparado. CRUE

- Adopção do Sistema ECTS como sistema de acumulação de créditos. Estela Pereira. Aveiro, 10 September 2000.

- IPTS /JRC Conclusions from workshop in Seville: EUROPEAN virtual UNIVERSITIES. June 2000

- Principes pour la mise en oeuvre de la Déclaration de Bologne dans les universités suisses (Bases pour les futures directives CRUS/CUS. 14 November 2001

- Panorama/RI UNIL. Le Système de transfert de crédits européens. Université de Lausanne

- Ponencia sobre la Armonización europea de las enseñanzas de la reunión de la comisión sectorial de secretarios generales de la CRUE. Carmen Ruiz-Rivas Hernando. Valencia, 10- 11 May 2001

- Documento Seminario Internacional: Sistema de la acumulación y transferencia del crédito. Portual. November 2000

- Bologna Declaration –A case study of collaboration. George Burns. Oslo, Norway, August 2001

- Conclusions of the work of thematic groups of Convention of European Higher Education Institutions. Prof. Dr. Konrad Osterwalder, Rector, ETH Zurich. March 2001

- Summary Tuning Educational Structures in Europe. Robert Wagenaar

- Report for the European Comission: ECTS Extension Feasibility Project. Stephen Adam and Volker Gemlich. January 2000

- SEFI's Opinion on the Joint Declaration of the European Ministers of Education. Brussels, 4 December 2000

- Sistema Europeo de Transferencia de Crédito. Guía del Usuario. Comisión Europea. March 1998

- Mise en oeuvre du système ECTS. Université de Genève. Evaluation et perspectives à l´Université de Genève. S. Cyprès et R. Lavigne

- La Declaración de Bolonia y su repercusión en la estructura de las titulaciones en España. D. Docampo, 21 September 2001

- Report of the Workshop: European Credit Transfer System as Basis for Generalised Courses Recognition. CUBER. January, 2001

- Consideraciones generales en la convergencia europea del sistema de enseñanza español. Dra. Julia González, Dra. Raffaella Pagani, ECTS Counsellor & Diploma Supplement Promoter, September 2000

- http://www.uoc.edu/web/cat/index.html

- The European Higher Education Area. Joint declaration of the European Ministers of Education, convened in Bologna. 19th of June 1999

- The issue of credit accumulation and transfer systems and the Bologna Declaration. Pedro Lourtie Leiria, 24 November 2000

Appendix: Calculation of student workload for ECTS credits[19]

If the idea of the average student is accepted, and ignoring the natural differences which occur in the rate of acquisition of knowledge, we can attempt a mathematical calculation of the number of credits required for a subject. The calculation assumes that the subject has a certain, previously-agreed level of complexity and that it must be studied in a prescribed amount of time. In this calculation, the following factors are important:

(a) The number of contact hours per week for the course unit
(b) Preparation before and finalising of notes after attendance of the lecture/seminar
(c) The length of the course unit in weeks
(d) The amount of independent work the student must complete to finish the course successfully.

To properly calculate a course unit's workload, it must be noted that this final category (independent work) can include:

- The collection and selection of relevant material.
- Reading of that material.
- Preparation for an oral or written exam.
- Preparation of written work or an oral presentation.
- Independent lab or field work, as the case may be.

With regard to the number of pages a student can read, the following rule of thumb is generally used (according to the University of Groningen, Holland):

- A first year student is able to read 4 to 5 pages per hour. Included here is the preparation for an oral or written examination. It has to be understood that this number is based on the notion that the information is not too compressed and/or complicated. For a philosophical text, for example, the number of pages will be lower.

[19] Discussion paper: Workload and the Calculation on ECTS Credit Points. Robert Wagenaar –University of Groningen)

- For more advanced students the number of pages which can be studied per hour is 6 to 7.
- The writing of one page of a paper requires 100 pages of reading. This number is based on the assumption that normal monographs and (scientific) articles are being used.

It is obvious that the calculation of workload in terms of credits in not an automatic process. The professor has to decide what the level of complexity is of the material that has to be studied per course unit. This defines the number of pages to be read per hour or the different formulas, specified above, for calculating student workload. It goes without saying that prior experience of the staff plays an important role in correctly assessing this. The different members of teaching staff involved in the course, and those outside, need to reach agreement on this level of complexity.

Actual calculation of workload

The best way to show how the number of credits is calculated is to give an example, which, in this case, is a seminar course at advanced level, which has the following characteristics:

Course characteristics	**Workload**	**ECTS credits (25-30 h ≈ 1 credit)**
Contact class time (2 hours per week)	2 h x 15 weeks = 30 h	1.0 credit
Reading of text of 330 pages	6 pages per hour = 55 h	2.0 credits
Reading and discussion of papers presented by other students (2 hours per week)	2 h x 15 weeks = 30 h	1.0 credits
Collection and selection of material *		1.0 credit
Collection and selection of material Writing of paper (15 pages) *	15 pages x 100 pages reading (per page) = 1,500 pages	9.0 credits
Total		**14 ECTS credits**

* Calculated only when the student has to select the material himself or herself

** 1000 pages =6 ECTS credits: 1000/6=ca. 160; 160 hours= 4 weeks= 6 credits