Collaborative Inter-University (European) Technology Teacher Education: Conception and Realisation

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The appropriate use of New Media makes collaboration between different universities (even Europe wide) in technology teacher education possible. In this way exchangeability and comparability of at least some part of the study courses in technology teacher education could be established.
Within this framework the faculty of TUD (Technology and Didactics of Technology) at the University of Duisburg-Essen, campus Essen, has developed a three-stage model to prepare and carry out e-learning: (1) standardised construction of multimedially oriented objects (to be developed by the different universities), (2) structured storing and combining of newly structured objects to modules by the use of an integrated developing environment (IDE), and (3) the use and evaluation of learning modules by using a communication- and learning platform in lectures.
Following the Open-Source-Idea, particularly in stage (2), two essential user interfaces are present: the MMDB-TU (Multi Media Data Base for Technology Education) and the bilingual IDE INTEGER (Integrated Developing Environment for the Generation of Learning Objects).
In a supervised and efficient way, INTEGER does not only allow the generation of modules from structured, stored objects but also their own evaluation and assessment by the user. INTEGER together with MMDB-TU is filling the gap between mere content and structured estimable learning objects. These are required later for the use of learning platforms to initiate further collaborative inter-university technology teacher education. The conception and realisation of this IDE is illustrated with examples.

Introduction

The results of the PISA-study of 2000 came as a shock for Germany. In its wake, the German gouvernment increased the number of support programmes and projects in order to improve the pupils' and students' literacy, their mathematical and scientific competence, and, especially, their 'computer literacy', their ability to deal with the new media. Millions of EURO were spent on the development of learning and communication platforms. There was much hope that those new, computer-based forms of teaching and learning could show the way out of the nation's educational misery. It should turn out soon, however, that reality did not come up to these high expectations, because the new methods of teaching and learning all had one weak spot in their conceptions. They did not focus on the learner. Quite the contrary, they were conceptualized to satisfiy the need of some programmers'

communities to exchange a huge amount of information. It was then when a new term was introduced: information literacy.
The call for information literacy still raised the same questions. How can pupils and students improve their competence in dealing with the new media so they can meet the steadily increasing standards of information literacy? The answer is very simple in a way: we have to integrate e-learning into our learning culture. We have to develop suitable learning scenerios for imparting knowledge by means of e-learning if we want to keep pace with the demands of modern information society. We have to become part of global communities that exchange, compare, and share information. The European universities could become such communities and thus be able to collaborate by appropriate use of the new media. The success of these collaborations could be increased by comparable standards of education. The current efforts to standardize the requirements on Bachelor courses of study in the various European countries point the way towards a comparable educational standard. It would be possible to establish similar European standards concerning the teacher training in technology, at least in some parts of the courses of study.
The aspects discussed above have one thing in common: modularity. Only a modular approach based on a common standard for describing data can be realized sucessfully. This approach is to be explained later in this publication within the framework of a collaborative Inter-University.

Point at issue
As information technological basic education focused on New Media is gaining importance, didactic, methodological and therefore also aspects relating to learning objectives and learning psychology are explicitly to be taken into account [1]. Moreover, particularities and framework conditions of whatever is relevant for learning with multimedial contents must be included. This means each subject has a particular characteristic which has to be strictly followed. In practice, however, besides some stipulated minimum criteria, a certain universality is often attributed to learning- and communication platforms in view of their fields of application. The existence of suitable content is simply taken for granted and the possibilities of standardisation are not debated.
Platforms such as WebCT, Blackboard or OpenUSS – to mention just some - are pointing to the right direction, but they are not universal and therefore not unrestrictedly applicable in any one subject. In this context WebCT and Blackboard are expensive commercially oriented products and OpenUSS has an insufficient administration for users and groups in place.
Available media for learning with electronic means are substantially characterised by the type of respective mediation (CBT, WBT, LMS, etc.). There is not a single learning- and communication platform on the market which is able to satisfy **all** specific requirements.
Therefore, the following question needs to be asked:

how is a didactically justified learning with multimedial contents through adequate use of New Media to be supported European-wide?

Model aproach

To any user standardised content should be available in a specifically structured form in a pool. In addition to search options and possibilities of a theme specific restructuring it should also offer consideration of didactical aspects. On this basis, contents that would give meaning to the use of a learning- and communication platform could eventually be prepared. A theme specific restructuring of content can be realised by using a modular approach. In this context, a staggered learning with multimedial contents is preferred to a learning through an exclusive use of learning- and communication platforms. A prerequisite is the media proficiency of the individual, which can go clearly beyond the mediation of information- and user specific basics and which is therefore in parts tied to specific characteristics of individual disciplines.

Within the faculty of Technology, an intensive mediation of media proficiency can primarily be achieved in the area of transcription of information via computer controlled events. At the same time this will provide an improvement of study skills within the faculty of Technology. In this context, the didactic added value which can thereby be achieved is of central importance.

The subject technology, at the university of Duisburg-Essen, Campus Essen, has developed a *three-stage model,* which has been specifically adapted to its requirements for the learning with multimedial contents as well as their assessment. It is organised in three inter-dependent stages in a discursive form:

- **stage 1:** standardised construction of multimedially oriented objects
- **stage 2:** structured storing of objects and restructured combining of objects to learning objects (learning modules, learning units, courses)
- **stage 3:** the use of structured learning objects by using learning- and communication platforms in presence courses.

In order to enable the realisation of this model for other disciplines, a conception is necessary which has been adjusted to each organisational and personal environment and adapted to the requirements and conditions of individual faculties.

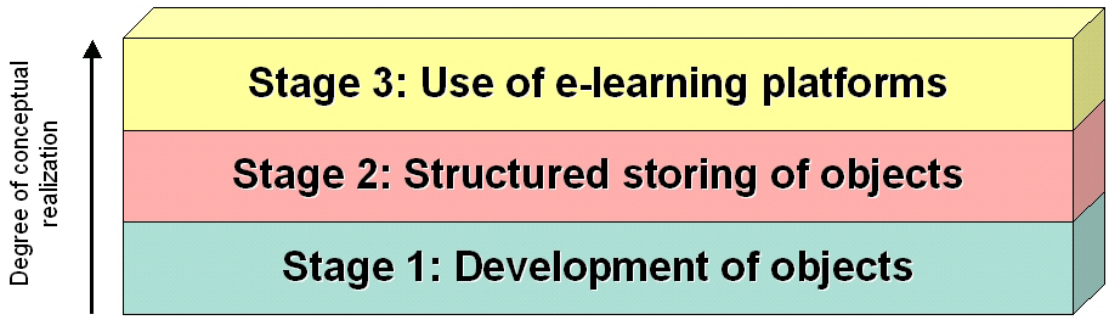


Figure 1: Three stage model for the learning with multimedial contents

A graphic illustration of the three stage model (figure 1), by specifying the degree of conceptual realization, points to the stages which build on each other. It thereby reveals all the way from the *standardised creation of content* through storing and combining *structured contents* to their final use in *e-*

learning or blended learning which evolves from it. In this way, didactically based learning with multimedial contents can be supported.

Development of objects (standardisation)

An undeniable prerequisite for supporting an European-wide learning with multimedial contents is the existence of content. It is available in very different formats and can be identified via the associated MIME type or via their filename endings.

Up until quite recently it used to be a common practice, within the framework of using New Media, to produce unstructured content and make it available to the user, no matter in what way. Just gradually the view, that in addition to scientific requirements *(technology product oriented)* didactical criteria *(pedagogy process oriented)* are increasingly gaining importance [2].

This fact is directly leading to the debate on a standardisation for the development of content. It needs however be considered that each content that is to be developed has a very specific target group. This requires additional user specific and learning psychological issues to be considered. It is not sufficient, for instance, to be able to control a commercial application for the generation of simulations (e.g. Flash) in terms of programming it. In fact the programmer needs to be clear about:

- in which specific discipline,
- for which clientele and
- for which learning objective

the content to be developed can be used. Only under consideration of this conditions a programmer will be in a position to programme meaningful interactive elements in a multimedia framework. These decisions can however only be made in a professionalizing process within the framework of sensible collaboration between programmers, scientists and pedagogues.

Structured storing of objects (structured content)

A sensible description of content through structured data records in order to safely find relevant information even after long periods is an old problem which has apparently still not been solved to a satisfactory level.

There is need for a long term solution not only for scantly developed possibilities of labelling in data records but also for problems that regard of inter-operability and portability.

Content descriptions through metadata offer a possible basis to resolve these problems. For metadata, which should be satisfactory for the criteria of inter-operability and portability, syntax as well as semantic are important.

Unfortunately there are very different concepts for an implementation of metadata records for all different areas. Only some of the important ones are to be briefly mentioned at this stage [3]:

- (X)HTML-Metatags[1]
- DCMI[2]
- IEEE LOM.

[1] XHTML on the basis of HTML 4.0 in terms of XML, offers extended specifications.

[2] Further concepts such as GEM, Warwick-Framework and IMS all use simple description elements of Dublin Core in varying degrees of complexity, extensibility and profoundness.

None of these metadata concepts are universally suited. Each is specially made for certain areas of application:
(X)HTML-Metatags provide a metadata structure which is indexed by most Internet based search engines but they are unsuitable for a profound description of content in the form of learning objects. The use of XML would offer a solution. Unfortunately, XML is complicated, can't present web pages and only describes their desired basic structure. And the final implementation must be made with HTML-derivatives, StyleSheets, scripting languages and external files.
The *DCMI* [4] provides a set of 15 basic elements for a structured description of objects. The integration into HTML is carried out with the support of Metatags and the description record after Dublin Core stands out because of its simplicity, for semantic compatibility, for international concordance as well as flexible extensibility and progressive compatibility with RDF. It provides standardised semantic information via digitalised contents. The conventions after DCMI are entirely supported by W3C and they are described concisely in RFC 2413 and in RFC 2731. The IEEE LTSC specifies this coherence.
The standard specified by *IEEE LTSC* and suggested in the standardisation IEEE 1484.12 [5] of the LOM Working Group does in fact provide comprehensive approaches for a systematic structuring of objects but it is highly complex and does not offer any generally accepted description format for multimedially focused elements.
It can generally be pointed out "that the exchange, the sharing of learning objects between platforms based on standards is a central, and in many cases unsolved problem" [6]. Meanwhile, in addition to approaches on the bases of the SCORM reference model, there are other approaches on XML basis [7] to ensure exchangeability and reusability of learning objects.

Use of e-Learning platforms (e-Learning)
As already mentioned above, e-learning or blended learning requires intensive consideration on a *technology product oriented* level as well as on a *pedagogic process oriented* level in order to reach an appropriate implementation of intended objectives.
The *technology product oriented* level is about the technologically relevant, implementable and administrative side of e-learning. Apart from the simple question which communication- and learning platform is to be suitably selected, the question about hard- and software is important.
This involves demanding requirements:

- The *hardware-side* requires a constantly available and reliably working network computer on a fail-safe basis (redundancy system).
- The *software-side* demands a reliably working operating system with effective rights administration and a proficient web server (UNIX or Linux, Apache).

It turned out from past experiences within the faculty of technology that a decentralised installation of a learning- and communication platform is more beneficial than a central one. Some of the reasons for this are faster administration and better access opportunities. In this context, aspects regarding hardware in view of fail-safety as well as software in vies of updating are to be taken into account. A very fundamental knowledge in the

area of computer hardware and respective operating system and the actual learning- and communication platform is required. Such an extensive administration requires an intensive involvement with the respective computer system and can only be delivered on the basis of an adequately efficient media proficiency.
On the *pedagogy process oriented* level, the notion of e-learning is deeply involved with the notion of e-teaching: both can be merged into the notion of e-education. Taking into account that not only the technological side plays a central role in this context but also the individual him- or herself, it is actually more correct to use the term "hybrid learning" or blended learning. This means that e-learning provides a methodological variant or complementary component within the individual learning process, which, if suitably applied, makes learning an objective oriented process. The model of self controlled learning is closely related but to be interpreted with care as the outcome of cognitive- and experiment-psychological research showed that the learner will often run into excessive demands [8].
Understanding e-learning as a superordinate for software based learning, the computer must not necessarily be in the centre of this form of learning. The fact is that e-learning enables place- and time independent learning.
Numerous trade fairs, international congresses, seminars and workshops are dealing with the central subject of using New Media and related e-learning in education (ICTE [9], PATT [10], LIT [11], TERC [12]). The essential point of these events can be described in one sentence and outlines the overall situation of e-learning: "During the authors‘ debate on developing learning techniques, the central question, which of the two was more important, technology or pedagogy, overruled the issue that learning is a social process which involves exchange and care as well as learning objectives and control over whether they have been achieved" [13].

Consequences
At this stage it becomes clear that behind every communication- and learning platform exists an organisational- and learning theory, which developers and users are only aware of in a minority of cases. Traditional education often requires only a minimum input while the creation of contents for e-learning demands a team of experts. However, it is the didactical concept in addition to expert knowledge that is essential.
Particularly in academic education which represents a blend between presence courses and virtual education the creation of time consuming media is not normally required. It turned out that for time efficiency, large quantities of material are accepted on paper while specific topics and short presentations are better based multimedially and interactively [14].
The three-stage model (standardised creation of content, structured content, e-learning) has proved itself at the University Duisburg-Essen, Campus Essen within the faculty of Technology. The didactical conception for learning with multimedial contents attached to this model contributed to questions not only of scientific contents but also of didactical aspects apart from issues regarding standardisation and structuring.
The success of this model was possible via a systematic implementation of it. Based on a L.A.M.P. approach, a multimedia database with integrated

developing environment has been set up, by which stage 2 of this model was implemented. During the work with the multimedia database (*mmdb*) didactical aspects of multimedial contents are emphasised and required from users. The export-function of learning objects enables an interface for follow up e-learning within the framework of a learning- and communication platform. On recommendation of the faculty of Technology the learning- and communication platform ILIAS is now used at the University of Duisburg-Essen, Campus Essen and centrally administered through the university's computer centre.

Focus on stage 2

Within the framework of technologies that are relevant for the Internet, the area of multimedia plays an increasingly important role. However, in order to use New Media in a meaningful way, it is absolutely necessary for all those who want to deal with these media to broaden their media proficiency. This is to be achieved on the basis of some basic education in information technology.

The contradiction, that not everybody can be an expert in all areas, but that at the same time demand for expertise exists in all areas, can only be resolved by giving all participants the opportunity to make their knowledge available in a structured way via simple but comprehensible user interfaces (figure 2). It follows that every potential user with some basic education in information technology should be able to use these interfaces even without specialist knowledge.

They are realised in a modular approach and a developing environment based on a database offers a convenient way to generate, amongst others, new learning modules with other focus areas. This developing environment offers a high degree in flexibility in dealing with New Media. And it can compose contents that are systematically grouped with the support of metadata in a structured way and with new focus areas.

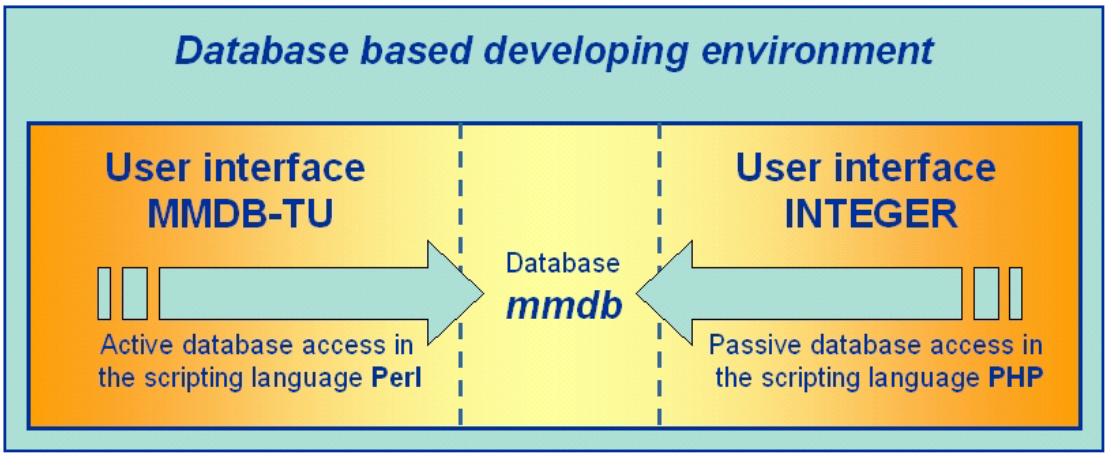


Figure 2: User Interfaces MMDB-TU and INTEGER

INTEGER together with MMDB-TU is filling the gap between mere content and structured estimable learning objects. These are required later for the use of learning platforms to initiate further collaborative inter-university technology teacher education.

Modular approach

The modular approach above mentioned has been realised in various projects within the faculty of Technology and Didactics of Technology TUD within the framework of technology teacher education [15]. It is essentially about the development of teaching and learning modules for the faculty. [16] The term module has been defined as follows: a module consists of at least two objects, which have been joined together into one coherent unit. An object is the smallest undivisible coherent unit (e.g. a picture, a closed text in any one subject, an applet, an animation, etc.) Modules are exclusively available in XHTML-format.

Objects/modules are always described through meta-information and entered into the database *mmdb* via the user interface MMDB-TU. DCMI is providing the basis for a classification in this context.

The database *mmdb* has been designed on the basis of this modular approach and only takes in data in a strictly structured form. It is a user interface, which has been specifically focused on technology teacher education for interactive dealing with multimedial contents. The basis of the MMDB-TU is the database *mmdb* and has been realised through a L.A.M.P.-approach (Linux, Apache, MySQL, PHP/Perl).

Concretisation

The approach according to L.A.M.P. is logically based on Open-Source-Products, which are available as free software not only European-wide. The widespread use of this approach is the result of the implementation of web-applications in professional areas through fail-safe web-servers/database-servers/fileservers. Such systems provide the basis for a focused use of PHP and MySQL in this field. The scripting language Perl is additionally used, not only because of its modular structure but also because of an unintended separation of code and layout for administrative purposes, as well as for the generation of dynamic websites. For instance, every authenticated entry/change of objects/modules in the database *mmdb* as well as their confirmation/evaluation by the database *mmdb* is exclusively realised through Perl scripts.

Objects with zipped record description files attached (zip-format), can on a system-administrative level be parsed with a Perl script and in this way automatically be read into the MMDB-TU.

Simple keyword searches and their logical associations are realised through the use of PHP. PHP is in this case the programming language, which is easier to use in order to specifically address the database *mmdb* with MySQL-commands, which have already been implemented. A keyword search will generate a result page of objects/modules which can be structured according to the user's requirements, e.g. according to attributes, functions, weighting of keywords according to the frequency of their appearance, etc. Also controlled by PHP, modules with a new thematic focus can be composed from the results and viewed online.

Perl scripts will finally ensure that modules with a new focus can be re-entered into the database *mmdb* or sent to the user as an e-mail attachment. Almost all websites (whether realised in Perl or in PHP) have been provided with

JavaScript elements in order to offer maximum efficiency to the user in dealing with the system. In particular, this language has been used for the implementation of help-functions, information windows and the generation of templates. In May 2001, a computer was set up on a raid system under Linux with the functions web-server, database server and file server. Since November 2001 it has been available for registered users under the URI http://www.mmdb-tu.de and http://www.integer-tu.de.

User interface MMDB-TU

Every object which has been entered into the database *mmdb*, regardless of which type of format, must be described in a data record according to DCMI. The user interface MMDB-TU has templates and various input masks available in order to instruct the user correctly.

The user himself is responsible for entering a data record, which describes the respective object as concisely as possible and in as much detail as necessary. The object is entered into the MMDB-TU exclusively on the basis of this information. It is possible at any time to change object data, which has been entered. Moreover, a help function has been implemented, which provides detailed examples and explication for entering objects and the formulation of basic elements according to DCMI. At the present time (January 2004), the following file formats can be entered into the database *mmdb*: htm/html, txt, jpg, gif, class and swf. In the near future, a gradual extension with the file formats wav and mpg/mpeg is planned. Further formats will follow upon request by the user community.

Every entered object, apart from its name, receives a definite object-ID. The respective user, as well as the system administrator of the database, *mmdb* are both informed about all entries. Every user has the opportunity to administer his entered objects/modules via his user specific, password protected access. A SSL support for such operations is currently planned.

Once the objects have been entered (figure 3), they can be composed into modules via the user interface INTEGER, which allows different or completely new focus settings (figure 4).

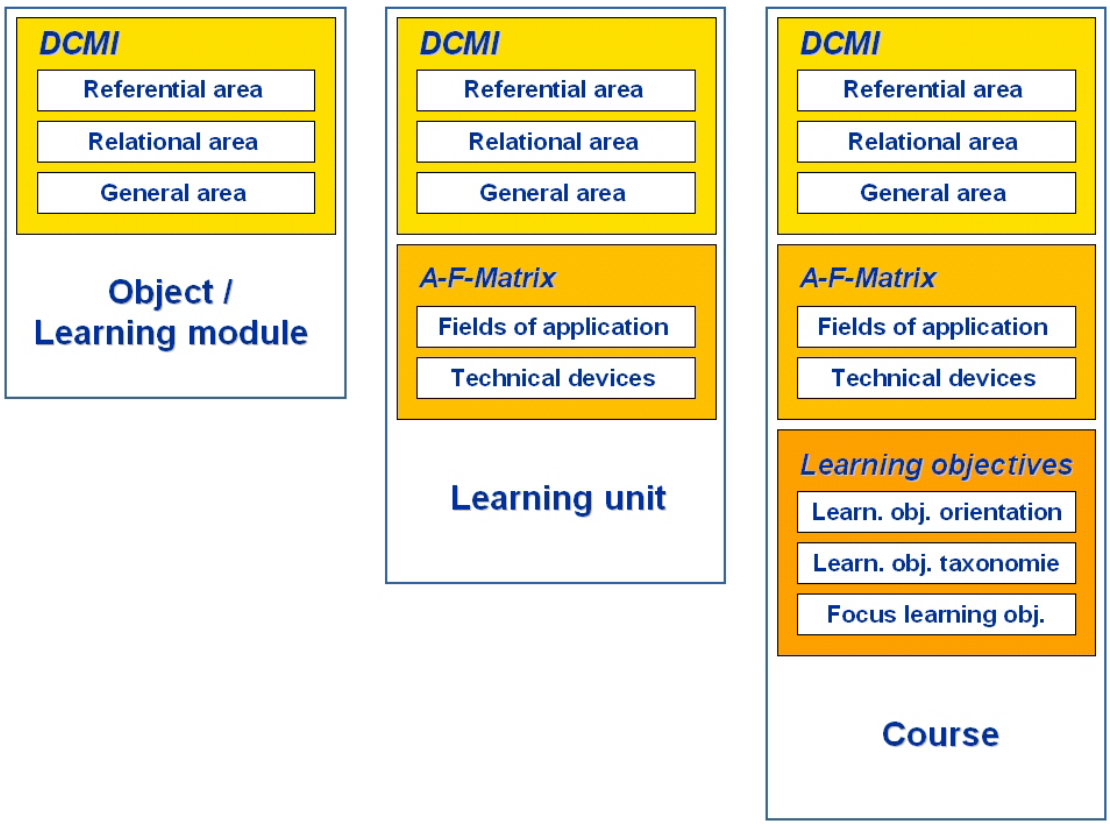


Figure 3: Modular structure (active access): entry of objects/modules

User interface INTEGER

The user interface INTEGER contains a search engine specially programmed for the database *mmdb*. One or several keywords, which can be inter-connected by logical associations are searched. This search can be narrowed, amongst others by previously selected elements from the attributes-functions-matrix. Based on the search results the opportunity to build modules of a basic type or of a higher order from existing objects/modules can be used. The most basic module (module of the basic class), as mentioned, consists of at least two objects. Such a module is described as a learning module below and can be re-entered into the database *mmdb* under a new record description according to DCMI.

During the generation of modules the user can decide himself which type of module is to be generated. Essentially, learning modules, learning units and courses are to be distinguished (figure 4).

Learning modules: during the generation of a learning module any chosen number of objects can be combined independently from the selected topic area.

A learning module (module of the basic class) consists of at least two objects. It is generated from a thematically unbiased list, which returns a search to the database *mmdb* as the result of a pure search. When saving to the database *mmdb*, a new data record according to DCMI is to be set up.

Learning units: when generating a learning unit, thematically clearly related contents, therefore closed contents, are created. A learning unit (module of the top class), or proposal, is generated from a thematically weighted and inter-linked list, which, depending on the weighting, returns the result of an

enquiry. When saving to the database *mmdb*, an entry into the attributes-functions-matrix must be made in addition to a new data record according to DCMI.

Courses: when generating a course, closed contents are represented under aspects, which are specific to the area of application.

A course (module of the hyper class), or variant, is generated from a thematically weighted and inter-linked list with a specific focus (from the area of the attributes-functions-matrix). When saving to the database *mmdb*, learning objective criteria (e.g. lecture- and class relevance) must be stated in addition to the entry of a new data record according to DCMI and to the new entry in the attributes-functions-matrix. Such a course therefore includes a didactically and methodologically well-founded procedure when choosing the topic area to be studied. It is retrievable with the additional use of learning objective oriented criteria.

Apart from its feature to generate modules, INTEGER thereby provides focused search options for the database *mmdb*. On the basis of a search term, and directed by search masks it is possible to search combinations of attributes, functions and fields of application and also to consider didactic aspects. With every found object (as for instance Gif-animations, Flash-simulations, Java-applets, HTML-texts) or module, the user is able to see the contents and attached data record description according to DCMI. He can in this way carefully decide which objects/modules he needs in order to generate a new individual module with a focus of his choice. After this he has the opportunity to enter the generated module into the database *mmdb* and a new description, matching the newly chosen focus, must be made. When viewing the search results, the user can finally make a simple assessment of objects/modules. He thereby makes a contribution to the maintenance and basic evaluation of the database. A final decision on the continued existence of the, in this way, evaluated, data, however, remains the responsibility of an editorially based administration.

New modules, generated by the user, are retrievable online at any time with suitable search criteria. It is also possible to have objects/modules sent by e-mail attachment in a zip format in order to enable continued work on them. In this context, legal issues (user- and copyright, etc.) have not yet been considered.

It needs to be mentioned that the user interfaces MMDB-TU and INTEGER, on the basis of the database *mmdb*, have not established an online system for evaluating self-assessment studies. Their collaboration makes modules available, which can be entered in existing e-learning platforms, ILIAS or OpenUSS. This fills the gap between mere contents and structured learning objects which are required for the use of learning platforms.

Target groups are universities and general education schools as well as teachers and students. In addition to specialist, subject related issues, also didactic aspects have been taken into consideration.

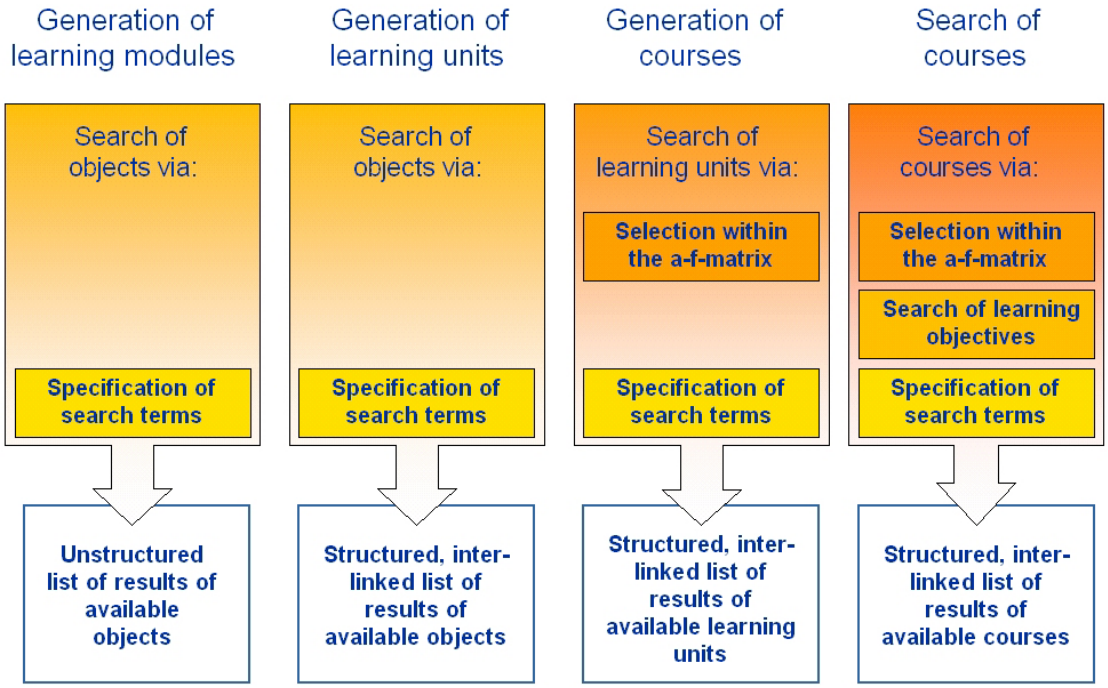


Figure 4: Modular structure (passive access): search of objects/modules

Asessment

A further element of the modular approach is the **modular coupling** which offers the option for an assessment of existing objects/modules. In this way it is possible to assess online any objects/modules available via the database *mmdb*. The additional option for assessment is databased and inseparably connected to the contents of the database *mmdb*. The author of an object/module is thereby prompted to consider the scientific correctness of his information. The following picture (figure 5) shows an example of a graphic visualisation of a form of Snellius' law of refraction, as an object with the affiliated object assessment.

By programming, a frame-structure is created which offers the option for assessment in the upper frame and shows the actual object/module to be assessed in the lower frame. The degree of usability can be selected by grading between *1* to *5*: *high* to *medium* to *poor* in the upper frame. In addition to this, the frame contains information on the *theme*, the *object/module-ID* and the e-mail address of the *author*. The median assessment of the object/module can only be viewed after submitting one's own assessment, hence after pressing the assess button.

This simple form of assessment has been chosen in order to offer the opportunity to the user community to administer their objects/modules themselves. Via e-mail, every registered user can draw the attention of the author of an object/module to possible corrections that might have to be carried out. After a time, set by the administrator of the database *mmdb*, all objects/modules are automatically checked in view of the assessments that have been submitted, and, if applicable, they are removed from the database *mmdb*.

The user community is thereby prompted to deal in a self-responsible, hence consistent way with the contents of the *databased developing environment*.

They are responsible for submitting and updating data records and ultimately they determine the existing database.

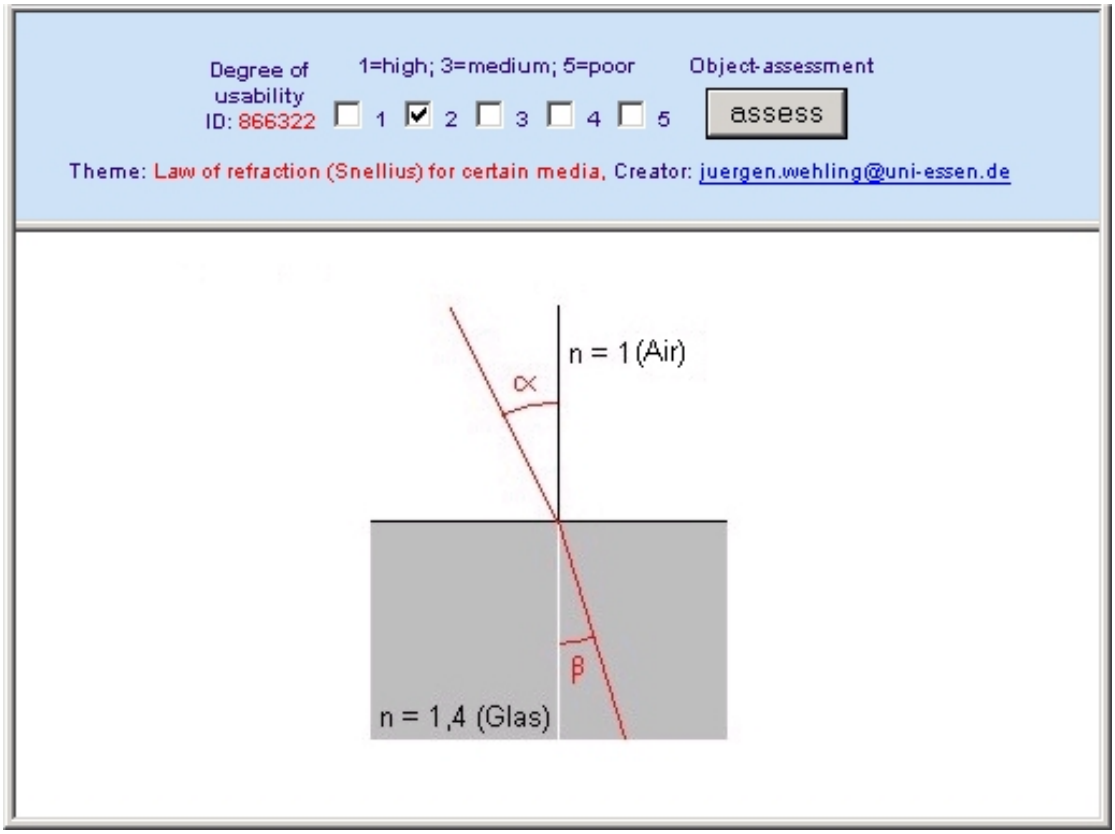


Figure 5: Modular coupling of object and object-evaluation

Screenshots of MMDB-TU and INTEGER

The two screenshots following demonstrate the ability of the MMDB-TU for the entry of objects in different ways (figure 6) as well as the use of INTEGER for the generation of a new learning unit (figure 7). Both user interfaces are available under the known URI http://www.mmdb-tu.de and http://www.integer-tu.de .

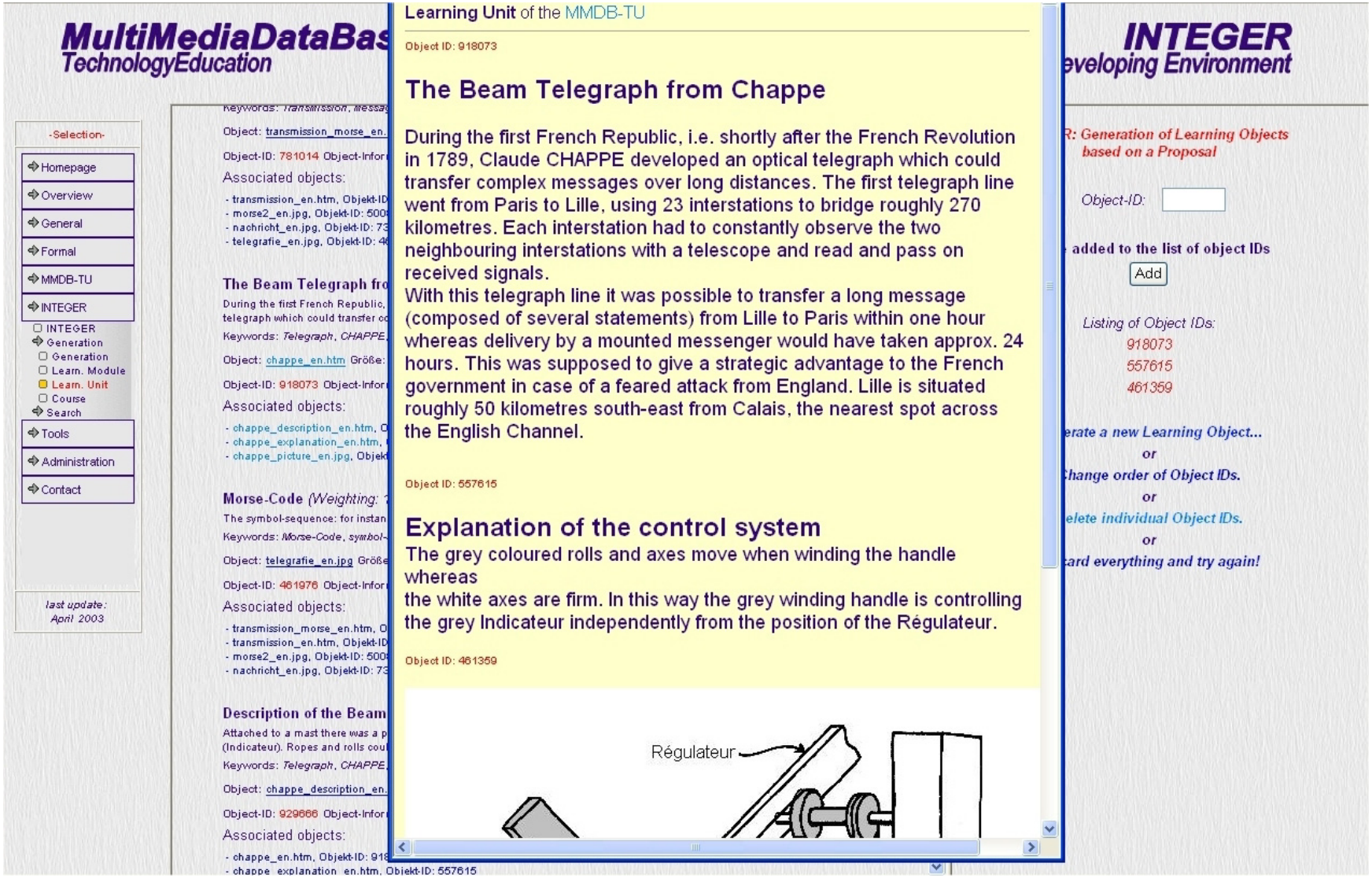


Figure 6: Generation of a learning unit

Figure 7: Entry of objects

MultiMediaDataBase
TechnologyEducation

INTEGER
Integrated Developing Environment

-Selection-

- Homepage
- Overview
- General
- Formal
- MMDB-TU
  - MMDB-TU
  - Entry
    - Entry
    - Object
    - Module
    - Extension
  - Correction
  - Generators
- INTEGER
- Tools
- Administration
- To the Author

last update: September 2003

MMDB-TU, Entry: Object

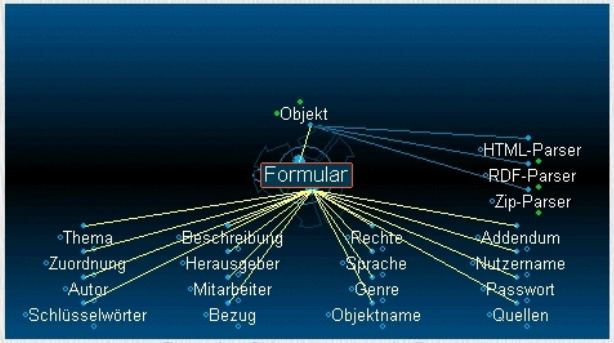
The term **object** stands for the smallest, not further divisible element, which can be part of a module. A module is composed of at least two objects.

In this way, an object can be e.g. a picture file (image.jpg) or an unformatted ASCII-text (description.txt). The entry-masks by which objects can find access to the MMDB-TU offer the possibility for searching their own data carriers for the object to be transferred. Once the object has been chosen, a transfer and an entry of the object into the MMDB-TU will follow.

The MMDB-TU offers multiple options to enter an object. In addition to the username and password, only e.g. a file has to be named which contains the object and/or the description of the object. It is possible to enter an object

- by means of a form, (*.htm, *.html, *.shtm, *.shtml, *.txt, *.jpg, *.gif, *.class, *.swf)
- on the basis of HTML, (*.htm, *.html, *.shtm, *.shtml)
- by using an associated rdf-file, (*.htm, *.html, *.shtm, *.shtml, *.txt, *.jpg, *.gif, *.class, *.swf) mit *.rdf
- via transfer of a zip-file.

The last option is reserved for administrative purposes.



Entry of an Object by means of a Form

After a successful entry a confirmation page will be issued which informs the user about the object-ID under which the particular object is stored inside the MMDB-TU. All specifications that have been made on the object can be found there. Specific details on the object which did not have to be explicitly specified by the user can also be transferred; e.g. the MIME-type of the object or its size. At the same time the user will receive an automatically generated e-mail which again contains all the relevant data for the object as well.

E-MAIL feedback@mmdb-tu.de

References and links

[1] Aufenanger, S.: Lernen mit neuen Medien – Mehr Wissen und bessere Bildung, Presentation: education quality forum, Series of Presentations: Wirkungen und Wirksamkeit Neuer Medien in der Bildung, 21,22/11/2002, *pdf-Document:* http://www.erzwiss.uni-hamburg.de/Personal/Aufenanger/Vortraege/Lernen mit neuen Medien Dortmund_Handzettel.pdf, referenced: 09/02/2003

[2] Baumgartner, P./ Häfele, H./ Maier-Häfele M.: E-Learning: Didaktische und technische Grundlagen, Sonderdruck, Perg: CD Austria Verlags- und Handelsgesellschaft mbH, 2002; *pdf-Document:* http://iol3.uibk.ac.at:8080/filer/peterManilaWebsite/peter/material/e-learning_sonderheft.pdf, referenced: 19/02/2003

[3] Holzinger, A.: Interoperabilität und Metadaten, Workshop on the 2nd Business Meeting "Forum Neue Medien", Wien, 2001, *pdf-Document:* http://serverprojekt.fh-joanneum.at/sp/thema/meta/metadaten.pdf, referenced: 20/02/2003

[4] Dublin Core Metadata Initiative, *Website:* http://dublincore.org, referenced: 20/02/2003

[5] Institute of Electrical and Electronic Engineers, Learning Technology Standards Committee, IEEE 1484.12 LOM-Working Group, *Webpage:* http://ltsc.ieee.org/wg12/index.html, referenced: 26/03/2003

[6] Interoperabilität und Metadaten, Themenworkshop am Wirtschaftsförderungsinstitut, Wien, 2001, *pdf-Dokument:* http://serverprojekt.fh-joanneum.at/sp/thema/meta/metadat-wsp.pdf, referenced: 14/07/2003, III

[7] Finsterle, L./ Rotard, M.: Mit konventionellen Autorensystemen zum E-Learning Portal, in: Klaus P. Jantke, Wolfgang S. Wittig, Jörg Herrmann (Publisher): Von e-Learning bis e-Payment, Berlin 2002, Akademische Verlagsgesellschaft, AKA, ISBN 3-89838-033-5, pp 111-121

[8] Weinert, F. E. (Hrsg.): Enzyklopädie der Psychologie, Volume 3, Psychologie des Unterrichts und der Schule, Göttingen, Hogrefe Verlag, 1997, ISBN: 3-8017-0539-0

[9] Wehling, J.: Lehrerausbildung für das Fach Technik im Gymnasium im Bereich “Informationstechnologie“, in: Technische Bildung, Ansätze und Perspektiven, 1st Edition, Frankfurt am Main, Lang Verlag, 2002, ISBN 3-631-38548-X, pp 261-266

[10] Wehling, J./ Haupt, W.: Data structuring of online-based courses for technology education, PATT-12 (Pupils' Attitude Towards Technology) conference for Optimal Use of Resources in Technology Education, Cape Town, South Africa, Beute (Publisher), 2001

[11] Langkau, T./ Rudolph, C./ Wehling, J./ Haupt, W.: Multimediales Lernen im Fach Technologie und Didaktik der Technik, in: Klaus P. Jantke, Wolfgang S. Wittig, Jörg Herrmann (Publisher): Von e-Learning bis e-Payment, Berlin 2002, Akademische Verlagsgesellschaft, AKA, ISBN 3-89838-033-5, pp 276-289

[12] Wehling, J./ Haupt, W.: Multimedia in Technology Teacher Education, in: Learning in Technology Education: Challenges for the 21st century, Volume 2, Gold Coast, Queensland, Australia, Centre for Technology Education Research, Griffith University, 2002, ISBN: 0-909291-74-8

[13] Schneller, A.: E-Learning tritt auf der Stelle, in: c't, Magazin für Computertechnik, Ausgabe 05/2003, Hannover, Heise Verlag, 2003, ISSN: 0724-8679

[14] FH Joanneum, Serverprojekt 2002, Newsletter August 2002 – Neue Medien in der Lehre, *pdf-Dokument:* http://serverprojekt.fh-joanneum.at/noflash/new/archiv/august2002.pdf, referenced: 25/02/2003

[15] Entry portal to the projects of the faculty of technology and didactics of technology, homepage: http://lpf.tud.uni-essen.de

[16] Wehling, J.: "Technische Bildung. Ansätze und Perspektiven: Lehrerausbildung für das Fach Technik im Gymnasium im Bereich Informationstechnolgie", Europäischer Verlag der Wissenschaften, 1st Edition, 2002, ISBN 3-631-38548-X, pp 261-266 (also available as Special Edition)