The trinity: towards a new Model of Learning Objects[1]

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Abstract

This article investigates questions regarding the setup and reusability of Learning Objects. The authors propose Learning Objects (LOs) as compound objects, consisting of an Information Object (IO) and an Educational Scenario (ES). These two parts are linked together by a specified Learning Target (LT), which is modeled after the taxonomy by Anderson & Krathwohl (2001).

In order to improve the concepts regarding the reusability of Learning Objects, this article analyzes the different components of the LO and their relationships to each other. Educational Scenarios (ES) are described as part of a hierarchy of different levels within the educational framework. The authors propose that a high reusability for Learning Objects is achieved through a flexible setup and reusability of the inner components of the Learning Object.

1 Introduction

In this paper, we concentrate on a strategic conception of learning objects, which is mainly motivated by the twofold goals of reusability and educational quality of the learning experience. Reusability in our terminology means the usability of learning material ("content") in different educational contexts. This is similar to the meaning in computer science and software engineering, where "a segment of source code can be used again to add new functionalities with slight or no modification" [W001]. We understand educational quality as the result of a consistent match of the different parameters of a learning situation (e.g. prior knowledge of the target group, personal, temporal, spatial, financial constraints etc.).

Our main research question in this respect is: How should learning objects for educational purposes be designed (to be structured, to be modularized etc.) in order to get the highest possible

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degree of reusability and – at the same time – so that the learning object fits the intended (planned, designed) learning situation.

This structural question is concerned with a meta-level of educational design: it should give us some rules, recommendations or at least some heuristics for strategies to design learning situations in a way, where they (or some part of them) can be reused. This question has to be guided by research results in education itself. What do we know about the learning process? And what kinds of strategies should we apply to make the learning process more efficient?

The term efficiency is not meant in a pure instrumental way. In our perspective, learning is not just a process of transferring content, but a social enterprise, which includes psychological aspects (like motivation and emotions) and social aspects (like the setting of the educational arrangements and the roles of the different participants in this process).

This consideration leads us to a different perspective. We will try to tackle the problem of reusable learning objects by introducing the learning context into the equation. In this paper we will put forward the hypothesis that for different purposes and in different contexts we need differently structured learning objects.

2 Three different paradigms for learning environments

Our first task is therefore to analyze, describe and categorize different kinds of learning contexts. Then, we have to determine what the consequences are for the construction of learning objects for each type of learning environment. Former investigations in this realm are summarized for our purposes here (Baumgartner, 2004):

We have grouped learning environments into three broad categories (cp. Figure 1):

1. Teaching I or learning mode I (to transfer knowledge from instructor to learner, or learners remember and understand, respectively): A teaching/learning paradigm, where the teacher has the control of the learning process and dominates the social (predominantly one-way) communication.
2. Teaching II or learning mode II (learners demonstrate the application of knowledge, or learners apply and analyze knowledge, respectively): A teaching/learning paradigm, where the responsibility for the learning process is shared between teacher and student and the communication structure has a dialogical nature. Students do their exercises and teachers observe and help them.
3. Teaching III or learning mode III (learners develop, invent, construct knowledge, or learners evaluate and create knowledge, respectively): A teaching/learning paradigm, where the responsibility for the learning process is taken up by the learners and the teacher's role is to support and guide this mainly self-directed learning process.

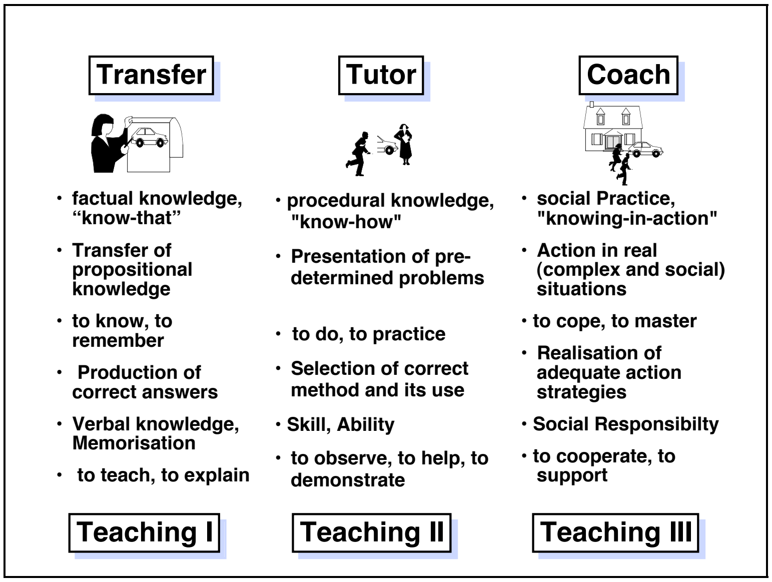

Figure 1: Teaching modes and learning environments (Baumgartner, 2004)

Looking at this general picture of learning situations, the role of content has changed dramatically between these three types of learning environments. These different functions of content are symbolized with the small picture heading in each column (cp. Figure 2). In the transfer mode (Teaching I), content has a much higher priority as in Teaching II. This is symbolized by the big flipchart in Teaching I and the small paper held by the teacher in Teaching II. In the constructivist mode (Teaching III), a special, prefabricated content disappears completely. Here, the content is hidden or buried in a complex situation and has to be found (reconstructed) or invented.

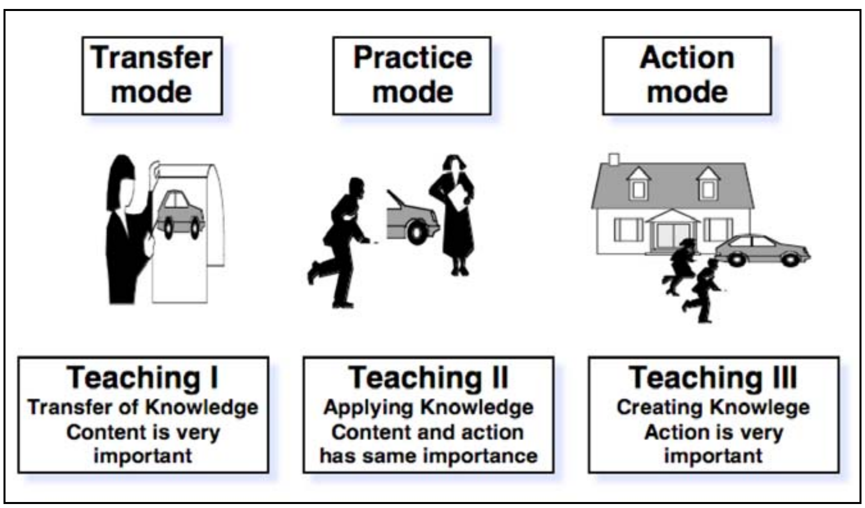

Figure 2: The role of content in three different learning environments

Therefore, the learning material is just one building block of the learning design and – in our perspective – not necessarily the most important one. In a constructivist approach, for example, poor content can even be the anchor point for an enthusiastic, highly self-motivated and inspiring learning enterprise to improve the material.

The value of content has to be measured against educational objectives and should – besides factors like accuracy, up-to-dateness etc. – not be judged in itself. What matters is the relation between content and a learning objective in a *specific* learning situation. The saying “content is king” only makes sense in a particular teaching/learning mode (for example, Teaching I, cp. above). Generally speaking, not content is the “king”, but the educational context [W004]. Informational content forms just one part of the complex learning environment.

We do not want to force a special learning model. Each type of learning environment has its role in the learning career of students. They may begin by digesting (remembering and understanding) some basic material. To improve their knowledge and to foster it, they may convert factual knowledge into skills by applying it to real situations. After these experiences, students could turn to real world activities and be able not only to get involved in complex situations, but also to discover or develop knowledge on their own. Or the other way round: students may work in a constructivist setting, and whenever they experience a lack of information they may look for basic material (factual knowledge).

Therefore, educational quality of the learning experience means to us developing and applying as much as possible a consistent match of all factors of the learning environment (previous knowledge, constraints in time, space and human resources) in order to achieve the learning objective of the participating learners in a specified learning context.

3 (Re)Constructing the term “Learning Object”

To attain the goals of reusability and educational quality, we propose a new way of constructing learning objects. This entails the separation of the learning object into three parts: the Information Object (IO) and the Educational Scenario (ES), which are tied together by the third component, the learning objective, which we will call Learning Target (LT). This concept and its implications are explained in the following sections.

3.1 Stating the Problem

What exactly is meant by “learning object”? Current literature contains several attempts for definitions of the term. The Learning Technology Standard Committee (LTSC) of the Institute of Electrical and Electronics Engineers (IEEE) writes, “a learning object is defined as any entity, digital or non-digital, that may be used for learning, education or training” (IEEE, 2002, p. 6). Wiley (2000) criticizes that the definition is too broad since it – if taken seriously – includes no criteria for boundaries or differentiation. All persons, places, things, and ideas of all time within the entire universe could be subsumed under this definition.

Looking from a pedagogical point of view, the attempted definition by the e-Learning Consortium at The MASIE Center (Hodgins, Dodds, Metcalf et al., 2003) is thought provoking (Figure 3).

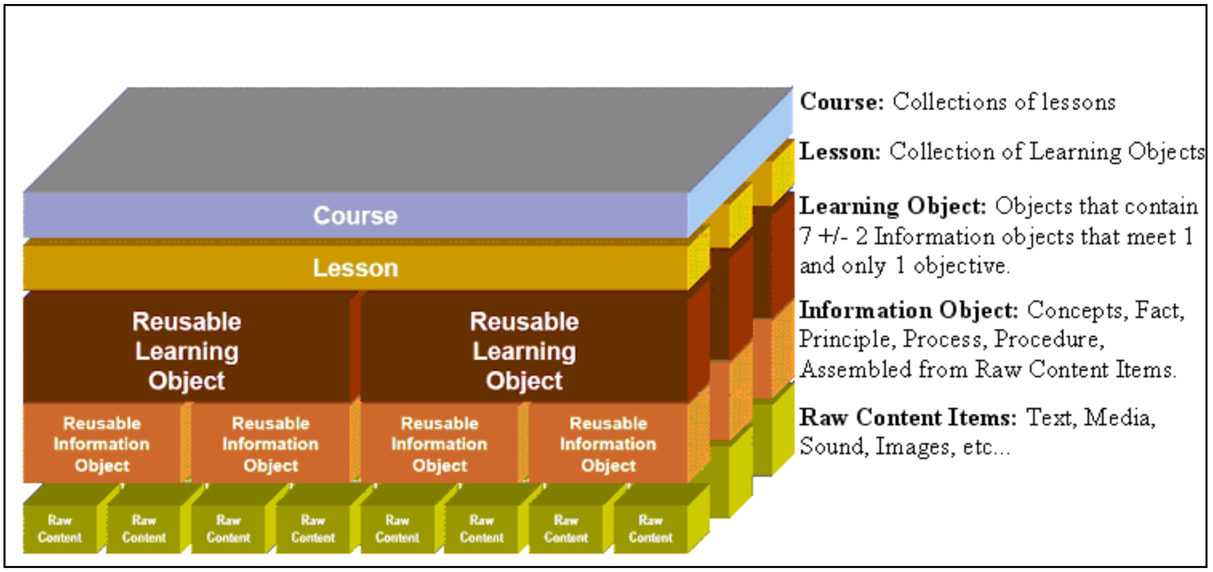

Figure 3: Autodesk Learning Object Content Model (adopted with slight modifications from Hodgins, Dodds, Metcalf et al. 2003, p. 60).

The autodesk learning object content model (cp. Figure 3) pleads for a hierarchical view on the different content levels and their correlations. The hierarchy starts at raw content (media objects or assets such as text, graphs, audio and video objects), and progresses via information objects and learning objects up to lessons and courses. The differentiation between information object and learning object is relevant for our purposes:

- The information object is described as an assembly of 1 - n (one to n) raw content items that serve to clarify an issue (an explanation of a fact, principle, process or procedure). This categorization of knowledge resembles Anderson & Krathwohl's (2001), which we will adopt for our purposes: factual, conceptual and procedural knowledge.
- The learning object, on the other hand, is a collection of five to nine information objects that support exactly one learning objective. The constraint of five to nine stems from the cognitive psychology investigations of Miller (1956), who proposed that short-term memory is limited in its processing capacity to 7 +/- 2 "bits".

From our perspective, Hodgins et al. (2003) deliver a narrower definition of a learning object that is interesting for two reasons: On the one hand, there is a distinction being made between information object and learning object. This is a distinction, which lies in the center of our approach as well. On the other hand, the objects in the lower part of the hierarchy (such as information objects and raw content items) are created without or only with little context dependencies in order for their reusability potential to remain high. The idea of the autodesk learning object content model is to *reintroduce* the context when information objects are assembled into learning objects according to a learning objective (Hodgins et al., 2003).

3.2 Consequences: A new Learning Object (LO) model

The ideas put forth by the e-Learning Consortium (Hodgins et al., 2003) are all essential in the production of reusable learning objects. However, one aspect is entirely missing from their line of reasoning: the learning activity. MASIE's concept of a learning object seems to be based on an understanding of learners as content consumers (transfer of knowledge, or consuming and digesting of concepts, facts, principles, processes, procedures, respectively), a paradigm, which is especially addressed by our Teaching I mode (cp. Figure 1). The omission of the learning activity becomes critical when the goals of the instructional process are skill or competency driven (Teaching modes II or III). Then, we need the integration of the informational content into a specialized and clearly defined learning situation – an instructional design issue that goes beyond the mere assembly of information objects. Thus, we propose the introduction of a new element into the concept of a learning object that rounds up the instructional requirements: the Educational Scenario (ES).

By introducing the concept of the Educational Scenario as a building block for learning objects, we are relating to the idea of McCormick (2003, p.10), who reasoned "those who seek to create learning *designs* seem to be moving away from building the pedagogy into the LOs [learning objects]". We propose an approach towards Learning Objects that encompasses an analytical separation of Information Object and Educational Scenario in the first design phase, and an integration of these two elements using a learning objective in the second design phase. The Information Object (IO) contains the structured placement of content while the Educational Scenario (ES) contains the procedure of how to interact with the Information Object in order to attain the learning objective.

As stated, our proposed model of a learning object comprises three elements (cp. Figure 4):

1. Information Object (IO)
2. Educational Scenario (ES)
3. Learning Target (LT) = the learning objective (we use the term target rather than objective to distinguish its abbreviation from the special term Learning Object: LO).

In our visual representations (cp. Figure 4 and Figure 5), the shape symbolizes a specific type of the Learning Object. Different shapes imply different components inside the object (e.g. another Information Object, a different Learning Target or a changed Educational Scenario).

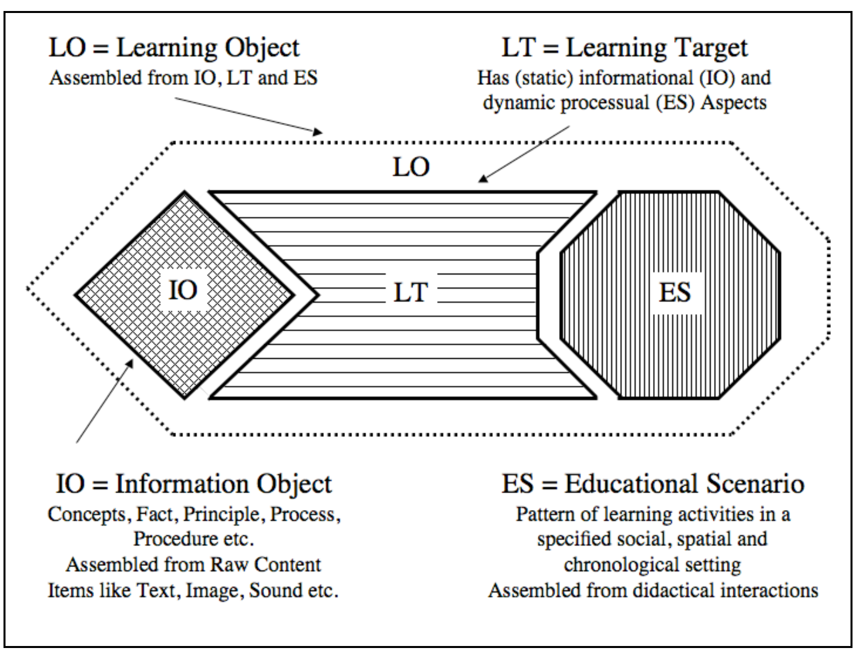

Figure 4: Learning Object Model

One aspect to note about our Learning Object Model is that the specifics of the three elements contained within the Learning Object determine the “shape” of the Learning Object itself: no longer does every Learning Object fit nicely with every other Learning Object. Therefore, the three Learning Object components and their ability to fit together determine the potential assembly of a larger module with several Learning Objects.

For the purposes of this paper, we focus on the inner parts of the LO. Instead of combining different LOs together as fixed building blocks like in the LEGO metaphor (cp. Wiley, 2000), we will investigate the inner dynamics and relationships of the three LO components. Our model therefore follows more so the dynamic atom metaphor of learning objects introduced by Wiley (2000).

4 Description of the different parts of Learning Objects

In the following section, each of the three components of our conception of a Learning Object will be explained in further detail. Subsequently, the mechanics of interplay between the three elements is discussed along with the tool that we use for the matching process: the Anderson & Krathwohl taxonomy (2001).

4.1 The Information Object (IO)

In our view, Information Objects (IOs) are content parts, which can be reused in different educational contexts and within different Learning Objects. Examples for Information Objects might be a textual and graphical description of the metadata model, or a scientific article on the specification of a certain eLearning standard.

The question of granularity is difficult to answer because, in our view, the granularity of the IO depends on the other two parts of the Learning Object, the learning objective, i.e. Learning Target (LT), and the Educational Scenario (ES). Many believe that the highest degree of reusability demands that IOs must be as small as possible (cp. Hodgins et al., 2003). A decisive constraint on their smallness is that they have to build a complete, closed and consistent information unit (Koper, 2001): References to other information units are forbidden, and the unit should provide all the information, which is necessary to understand the problem at the intended level of complexity.

From a technical perspective, on the other hand, the smallest IO is an object, which the learning management system can handle – these are media objects determined by different file formats such as pictures, text, audio and movie files.

From an educational point of view, we have to add another required condition coming from the Learning Target: the Information Object has to be able to serve a specified educational objective. In standard learning situations, however, this supposed educational constraint for the granularity does normally not reduce the size of IOs, as a sensitive educational objective in almost all cases requires more than one small IO. Therefore, the Learning Target would be of no use in limiting the size of an Information Object. Along the findings of atom theory, where still smaller parts and components of atoms such as quarks are continually being discovered, we believe that there exists no smallest or even optimal size for an Information Object. Its size will always depend on the context it is being used in.

4.2 The Educational Scenario (ES)

The Educational Scenario is a script that describes an educational situation. In our understanding, Educational Scenario is a technical term (therefore the capital letters) and characterizes a specific learning situation. The specification of an ES comprises not only activity and task, but also the social and physical setting of the learning situation. Take the simple example of giving a talk: Giving a talk in which situation? It means a big difference if it is a live talk in the presence of a live audience, or if it is a talk given by way of media communication. The situation even differs depending on the type of chosen media (radio, TV, Internet), or in what kind of framework the talk is embedded (school, conference), or with what kind of motivation the talk is held (to get a degree, to share views among peers) etc.

The concept of a "scenario" is adopted from the theater or movie language. There, it is a script to describe the essential factors of a screen play. It is not by coincidence that the technical specification IMS Learning Design (Koper & Tattersall, 2005), which provides a language for describing learning activities in a standardized way, has incorporated exactly this kind of vocabulary: scene, act, play etc.

4.3 The Learning Target (LT)

We refer to learning objectives as Learning Targets. We have done so in order to distinguish the abbreviations of Learning Object (LO) and Learning Objective, and therefore chose the term Learning Target (LT) instead. Learning objectives have received manifold definitions. Since we will use the Anderson & Krathwohl taxonomy to tie together the elements of the Learning Object Model, we also adopt their definition of learning objectives: Learning objectives consist of a (cognitive) process along with a knowledge specification (Anderson & Krathwohl, 2001).

Examples of learning objectives, following this definition, are

- Learners will be able to explain the rationale behind the eLearning standard IMS Learning Design.
- Learners will be able to judge the state of the art of the ePortfolio standard.

4.4 Integrating the three Learning Object Components

Tying the three components (Information Object, Educational Scenario, Learning Target) together to form the Learning Object, we propose a tool: the taxonomy by Anderson & Krathwohl (2001). This taxonomy is a recent revision of the widely used "Taxonomy of educational objectives" (Bloom, Engelhart, Furst et al., 1956).

We suggest using the taxonomy by Anderson & Krathwohl (2001) as a heuristic tool in order to generate an understanding of the characteristic of the Learning Object. An overview of the Anderson & Krathwohl taxonomy is shown in Table 1. The taxonomy is set up so that within each dimension the higher categories integrate the lower ones, an example of an inclusive, hierarchically ordered system. For instance, the cognitive process category Apply integrates the categories Understand and Remember, while the knowledge category Procedural Knowledge integrates the categories Conceptual Knowledge and Factual Knowledge.

As the taxonomy by Anderson & Krathwohl has two dimensions consisting of a knowledge dimension and a cognitive process dimension (cp. Table 1), it qualifies as a suitable candidate to demonstrate our approach and tie the three Learning Object components together. The knowledge dimension will address the relation of the Learning Target to the Information Object, while the cognitive dimension addresses the relation of the Learning Target to the Educational Scenario. We are aware – as Anderson & Krathwohl are – of the restriction of the cognitive domain and its omission of motor-psycho (skills) and affective (emotions) dimensions.

The Knowledge Dimension	*The Cognitive Process Dimension*					
	1 Remember	2 Understand	3 Apply	4 Analyze	5 Evaluate	6 Create
A: Factual Knowledge						
B: Conceptual Knowledge						
C: Procedural Knowledge						
D: Meta-cognitive Knowledge						

Table 1: Taxonomy by Anderson & Krathwohl (2001).

This two-dimensional taxonomy is generally used as an aid during the instructional design process: each learning objective, learning activity or assessment item (such as an essay question) receives a categorization for the knowledge type and the cognitive process. For example, the learning objective "Learners will be able to explain the rationale behind the eLearning standard IMS Learning Design" receives a categorization *(B) Conceptual Knowledge* within the knowledge dimension, and *(2) Understand* within the cognitive process dimension; a mark is placed in cell B2 for this learning objective. The taxonomy then serves as an aid in determining, whether learning objective, learning activity and the assessment of the learning process are in alignment. For the example just posed, this means that the learning activity and assessment item should both also receive a B2 status. However, Anderson & Krathwohl (2001) argue that learning activities might also receive a higher status, for example B3, in order to fulfill a learning objective placed in B2.

The taxonomy serves for our purposes as a tool for matching Information Objects and Educational Scenarios via Learning Targets. For instance, we first create a Learning Target and categorize it into both dimensions of the taxonomic table (cp. Table 1). Then, we will look for matching Learning Object components by

- locating Information Objects that received the same entry as the Learning Target for the knowledge dimension, and
- by locating Educational Scenarios that received the same cognitive process categorization as the Learning Target.

Applying this process immediately limits the number of Educational Scenarios and Information Objects that we can use for a specific Learning Target, and at the same time, we are building on the idea of aligning learning objectives (Learning Targets) and learning activities (Educational Scenarios) to create sound educational experiences.

5 Exploring the proposed LO model conceptually

5.1 The interplay of the different parts in the LO model

To demonstrate our concept of reusability, we will present two varying examples of the different components of the Learning Object model. As an example for content, we will use learning material on eLearning standards. Figure 5 illustrates the two variations we are going to explore:

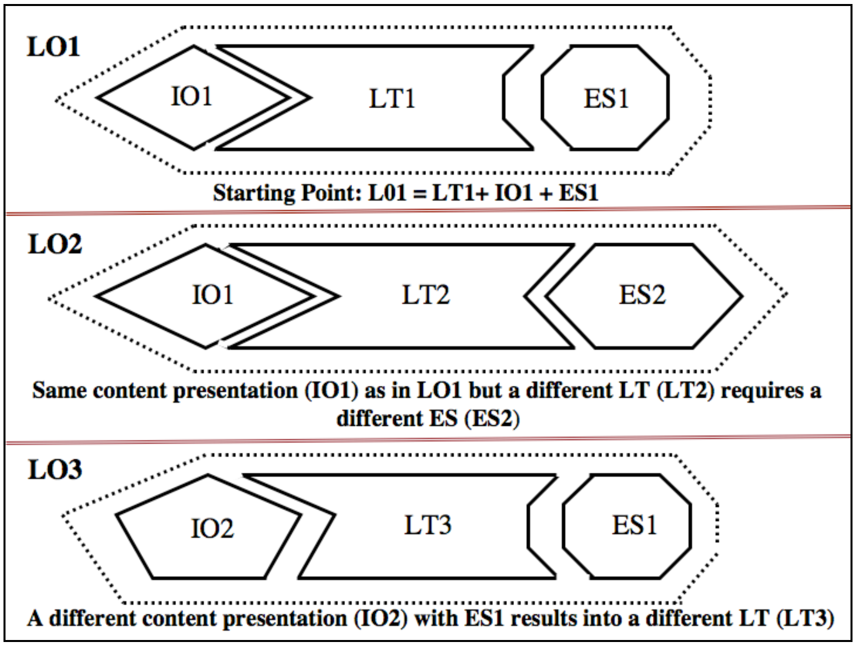

Figure 5: Each variation of IO or ES changes the LT

Our starting point is the LO model in Figure 4, which is also shown in the upper portion of Figure 5. To distinguish the different parts during our systematic variations we add indices to the objects: LO1 = LT1 + IO1 + ES1 (cf. upper part of Figure 5). IO1 represents in our example introductory content on the subject matter of eLearning standards. It is for our exploration not important, which media type is used to present this specified content (hard copy paper, portable document format, HTML-webpage, slide show etc.). It will suffice to say that IO1 gives an overview on different standards, consists mainly of text, but also includes some graphics, images and tables.

The teacher gives a talk on the subject (= ES1). This can be in front of a live audience, or via radio, audio conferencing or podcasting. For a detailed analysis, these differences in media are important. For the line of argument in this paper, we will neglect them. Here, we are just interested in the interplay of the different parts concerning reusability.

IO1 and ES1 are linked together by the LT1. We assume the following Learning Target: Students will be able to summarize the importance of eLearning standards (Anderson & Krathwohl taxonomy cell: B2) and be able to name some of the most important standards like Learning Object Metadata (LOM), SCORM etc. (Anderson & Krathwohl taxonomy cell: B1). How to state and categorize Learning Targets was covered in section 4.3 “The Learning Target (LT)”.

In our example, we started out with the content selection. In teaching practice, the line of reasoning is inversed: Instructors often start their lecture plan with a learning goal in mind. They consider their constraints and available resources and then take (select, write etc.) the content they find adequate for a specific learning situation (the selected content is their IO). Sample applications could be to present the content in a talk, to distribute the content and engage students in group work etc.

It is important to note that for some instructors, the highest priority is the Learning Target. This central role of the LT is in our model expressed through its double linking function: one "side" of the Learning Target is orientated to the informational and another to the educational aspect of the Learning Object. In practice, many teachers choose the design of adequate content as the second step after their decision on learning objectives. However, the teachers' instructional design could focus in the other direction of the learning objective as well: having a specific LT in mind, teachers could first choose an outstanding motivating ES, and afterwards design their content especially for this engaging learning situation.

We would get two different workflows for building a Learning Object depending on which design decisions follow the creation of the Learning Target:
1. LT → IO → ES (common approach)
2. LT → ES → IO (alternative approach).

5.2 Variations in Educational Scenarios

It is intuitively clear that we could use the same Information Object IO1 from our example (the content overview on eLearning standards) for different educational situations. For instance, we could use IO1 not just to remember or to understand eLearning standards, but we could reuse it in another situation with other – more advanced – students. In this second example, the students would take this content just as a starting point to analyze, evaluate, criticize, or even improve the text presented in IO1. These latter activities require different Educational Scenarios (giving a talk as in ES1 is not adequate anymore for the Learning Targets analyze, evaluate, criticize or improve), but the IO could remain the same for both instances. We choose a new Educational Scenario E2: a writing exercise including a peer review cycle. For the second Learning Object LO2, we keep the same Information Object IO1, but substitute the new Educational Scenario ES2 to achieve a new Learning Target LT2: LO2 = LT2 + IO1 + ES2 (cf. middle part of Figure 5). The reusability of LO1 is based on a different Learning Target and therefore requires an alteration in the Educational Scenario.

5.3 Variations in the Information Objects

We can easily understand that the same Educational Scenario can be used across different subject matters, for instance, organizing one day a group discussion on eLearning standards, and another day a group discussion on the global warming problem. Yet, this connotation is not meant when we talk about using different IOs. When looking at varying IOs, all the variations have to be done in the same subject area! (Here, we are not interested in the reuse of the exact same objects at another time or by other teachers under exactly the same IO/ES conditions.) With the different shapes of IOs, we want to characterize that different IOs also use different resources (raw content like text, sound, image) to describe the same subject matter, in our case for the subject "eLearning standards".

Instead of some introductory text like in IO1, we could provide students the original specifications of the standards, or links to some examples of their implementation in a new Information Object IO2. Despite the same Educational Scenario ES1 "giving a talk" being used in this new LO3, the more advanced content of IO2 makes this a different lesson with different Learning Targets suited for more advanced students: LO3 = LT3 + IO2 + ES1 (cf. lower part of Figure 5). Again: The reusability of one of the inner parts of the LO (in this case of the Educational Scenario) is based on a different Learning Target.

5.4 Variations in the Learning Targets

If we now inspect these changes and compare the shapes of the different Learning Objects in Figure 5, we notice the following feature: Every change of the IO *and* every change of the ES requires an alteration of the Learning Target as well. The LT is the "missing link", which glues the IO and ES together. We can think of the Learning Target as the central piece of a learning design – which, from an educational perspective, is evident!

Figure 5 gives us a better understanding of reusability. It is not the Learning Object alone, which has to be watched for reusability but its inner parts as well. We can see that reusability of Information Objects *and* reusability of Educational Scenarios are implied in Figure 5. As in our proposed model, the shape of the LO is the result of the relation of its inner parts. One conclusion is that we should focus our attention on these inner parts of the Learning Object to improve reusability.

6 Exploring the proposed Learning Object Model educationally

6.1 Describing the curricular context

Until now, our considerations have been on a conceptual level. Their consequences for the real educational design are not clear at the moment. We will now turn to an educational example to demonstrate the usefulness of our proposal and to elaborate the consequences of our proposed Learning Object model.

The sample design will be for a class of 40 people, most of them high school teachers of different subjects. The average age of the participants is between 35 and 40 years, but the ages of the participants typically range from 26 to 55 years.

We will describe a small part of our new continuing education curriculum on eEducation (Masters of Arts) at Danube University Krems (DUK). It is a program with a student workload of 2250 hours total, scheduled for 4 terms (2 years). 2250 hours equals 90 European Credit Transfer System (ECTS) points, e.g. 1 ECTS = 25 hours of student workload. In our examples, we will focus on a specific part of this curriculum: the course on Educational Technology II, which is designed for 6 ECTS (150 hours) and features a content block of 75 hours (= 3 ECTS) that regards our mentioned example on eLearning standards.

6.2 Looking into the educational hierarchy

6.2.1 Time as a measure for granularity

If we examine our consideration about the curricular context, we notice that we have different parts or building blocks of the curriculum. We mentioned above the content block (3 ECTS) on eLearning standards as part of the course on Educational Technology II (6 ECTS), which in itself is just a module of the Masters programme (90 ECTS). Yet, the smallest curricular part – the content block – is itself composed of different learning situations. We therefore have a hierarchically ordered structure of different layers (Flechsig & Haller, 1977; Flechsig 1983, 1996), which we are now going to describe in more detail.

As the fundamental measure to distinguish between the different levels, such as the Educational Technology II course and the Master's Programme mentioned above, we choose the typical timing that is necessary to complete the educational task of the specified layer in the hierarchy. This gives us some kind of approximation of the boundaries of each layer. We will call the optimal time span for an educational activity the granularity of this layer.

Granularity is therefore a concept, which belongs to a certain layer in the hierarchy of the Educational Framework (cp. Figure 6). It is an abstraction and does, therefore, not necessarily have a specific physical counter part. In the herein described hierarchy of educational layers, it makes no sense to speak of equally sized physical objects. Instead, we prefer to talk about (roughly) equally timed educational actions in learning situations (regarding the micro-, meso-, and macro learning situations, cp. Figure 6) and equally timed curricular components within the layers Module and Curriculum. Even regarding the highest layers (Institution and Policy, cp. Figure 6), we are confronted with some characteristic time frames, which typically last much longer and which, at this point, cannot be specified in detail (e.g. the typical "life time" of an institution from its foundation until its disappearance or mergence with another organization).

We get an inclusive hierarchy of different layers ordered by their typical granularity measured by time. Inclusive hierarchy means that every higher stratum contains the lower layers.

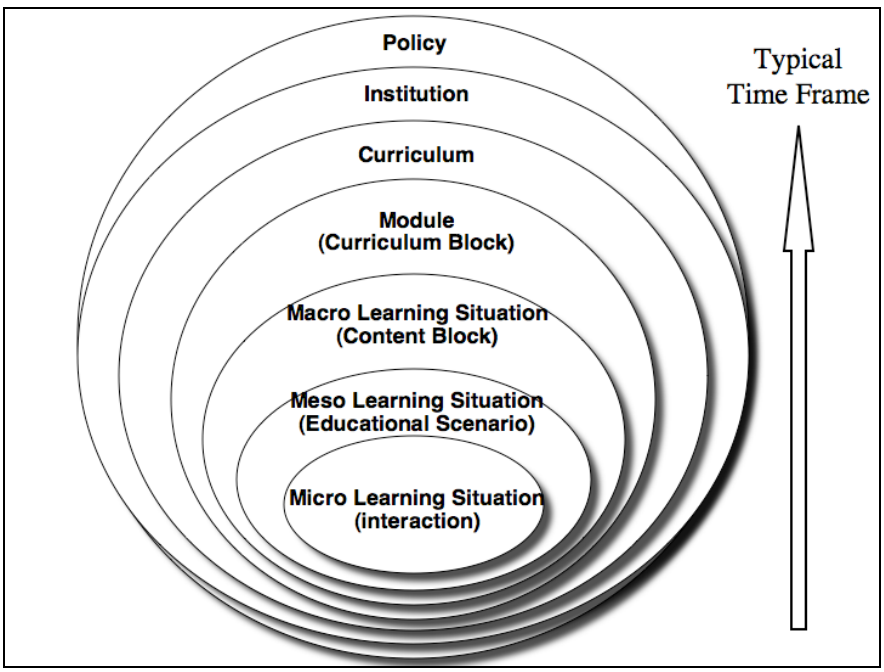

Figure 6: Hierarchical Levels of an Educational Framework

6.2.2 Micro Learning Situation

The micro learning situation is formed by interactions between instructor and learner(s), learner and learner(s), and learner and object(s). A micro learning situation has a typical time range from seconds to minutes. Examples are asking and answering a question, writing a post in a forum etc. Not every interaction is meaningful in an educational sense, however: To hit the enter key in a Computer-Based-Training program to get to the next screen is just a control action and from the educational point of view not necessarily a didactically relevant action. In this paper, we will not elaborate on this very basic layer.

6.2.3 Meso Learning Situation

The meso learning level is our main concern in this paper. This layer is directed towards a certain didactical situation (e.g. “lecture”, “group work”, “problem solving” and so on). This is the layer, where the Learning Object with its inner components (IO, LT and ES) is settled. The typical time frame (granularity) of learning ranges from some minutes to some hours. We will elaborate on this layer in the next chapter.

6.2.4 Macro Learning Situation

The essence of this layer is determined by the subject area or content aspect. The macro learning situation is a block of teaching or learning situations, which together form a certain closure in the learning process. Essential for the closeness is the subject-matter-related point of view: Which knowledge has to be covered by the requirements of the curriculum and belongs – regarding its content – together? It is the block of related content, which is typically covered in examinations.

Pragmatic considerations, at least in our Danube University example, usually govern the determination of the optimal size for these blocks: the student workload needs to be measured in ECTS credit points. As it is common not to consider fractions of credit points, the smallest possible time frame is 1 ECTS credit point (25 – 30 hours of student workload).

Each macro learning situation consists of many – yet countable and therefore specifiable – meso learning situations. In this paper, however, we will not focus on this level of macro learning situations. The description of micro and macro learning situation herein was necessary in order to get the entire picture of the different levels of learning situations.

6.2.5 Module

In the next level of the Educational Framework, we leave the level of learning situations altogether and enter the domain of the curriculum. The module is a specified building block of a curriculum and usually specified with some headings describing different subject areas, blocks, or macro learning situations. The module is usually calculated in ECTS credit points.

The granularity of the module typically depends on pragmatic considerations of the curriculum design: What is the best unit of measurement to combine different modules in order to form the complete curriculum? Assuming a Bachelor’s Degree with 180 ECTS and a Master’s Degree with 120 ECTS, a division into 3, 4, 5, 6 even 8 ECTS (75 to 200 hours of student workload) may appear feasible. It has to be a unit of measurement, which can be put together easily to courses or other student activities, such as project work, or the writing of a Master’s thesis. The mutual recognition of ECTS credit points on a national and international level has also to be taken into account when considering the granularity of modules.

6.2.6 Curriculum, Institution and Educational Policy

The granularity of the curriculum is guided by national law and international agreements. The curriculum’s value will be judged by the requirements for getting the educational certification (e.g. Bachelor’s degree). There are so many different regulations as there are different professions. Flechsig (1996) therefore distinguishes two more layers: The layer of the educational institution and the layer of the national education policy. Nowadays, we may even add an international level as well. At this point, we will not go into more detail, since these levels are only of peripheral interest for our main concern – the reusability of Learning Objects.

6.2.7 Intermediate Conclusions

What we get from the exploration of the educational framework is a stratified inclusive hierarchy of educational settings, which form together the international educational framework (cf. Figure 6). Again, inclusive hierarchy means that every higher layer integrates the lower layer. From the seven different layers introduced in Figure 6, we will now focus on the meso learning situation, the second layer, which hosts the Educational Scenarios. Therefore, we also have to take into account the first and third layers (i.e. micro and macro learning situation) because as immediate neighbors they influence the Educational Scenario and serve as transition points.

7 Exploring Educational Scenarios

7.1 Why do we need Educational Scenarios?

We will now go into more detail regarding the second layer of the educational hierarchy (cp. Figure 6). We have said that this level is orientated to a certain didactical situation like "presentation", "group work" and so on. It is our conviction that one of the biggest challenges in educational theory is to overcome these rather abstract didactical concepts. The descriptions of these didactical notions are too general since these situations can be implemented in a range of different ways. There are many different kinds of "presentation" and many different kinds of "group work". These abstract didactical settings give us at times just an orientation for the predominant teaching/learning mode (I, II or III, cp. Figure 1). So we could say, for instance, the didactical situation "presentation" would belong to Teaching I. Yet, already with the second example "group work", we have a problem: It could be a group exercise (Teaching II) or a collaborative creative act (Teaching III). Yet, even if we are able to detect the predominant teaching/learning mode, this is not enough for the practice of educational design. Thus, we need a much more defined description for the educational situation.

The first step in this concretization is to deliver an activity-based description for instructors and learners. Examples are "giving a talk on eLearning standards" (instead of "lecture"), "inquiring collaboratively the pros and cons of IMS Learning Design" (instead of "group work"), or "presenting the results of an investigation into the metadata approach" (instead of "presentation"). These descriptions are all activity-based and task-oriented, e.g. they specify the activity, the task and the subject matter. Yet, they are still rather general and cannot describe in full detail the concrete educational settings. For instance, a presentation could be delivered by a speech in front of an audience, with the audience being present or distant, and with the audience being able to immediately interact or not.

For our line of argument it is important to stress two points about Educational Scenarios:

1. It is essential and typical that an ES includes the detailed description of the social and physical settings: How many people interact? In what roles do they interact? In what kind of spatial surroundings do they interact? How long does each of their activities last?
2. It is important to understand that at this level the description of the educational setting is not determined by content or specific subject areas. A presentation, whether implemented in form of a talk or as a Ball Bearing scenario (see the following example), can be designed for any kind of subject.

7.2 Educational Scenario Example “Ball Bearing”

The Ball Bearing method (German: Kugellager) can be used to prevent an endless sequence of ”talks in front of an audience”. For instance, different student speakers may one by one present different eLearning standards to the audience. These series of talks tend to get boring for the audience. The activation of the learner audience is low; many times students are just waiting for their turn to present.

To understand the specifics of the Educational Scenario Ball Bearing, we continue our above mentioned example of 40 participants of the block inside the Educational Technology II course. For the implementation of the Ball Bearing method, we first distributed informational material on eLearning standards. In groups of four persons, the students investigated one of ten different eLearning standards. After the group investigations, half the course participants formed an inner circle, while the other half formed an opposing outer circle (cp. Figure 7). The inner circle of learners– and this is the reason for calling this Educational Scenario “Ball Bearing” – is shifted one station clockwise each time a central signal is given. During a fixed time frame (e.g., five minutes), the members of the groups in the inner circle present their findings using posters, notes or even computer presentations. The outer circle remains fixed as the inner circle wanders by a central signal (e.g. a bell) to the next station. When the circle is thus completed, the participants change roles – the inner circle people switch with the outer circle people and the second half of the Ball Bearing process begins by repetition of the procedure just described (cf. [W002], a project work by DUK students where the Ball Bearing scenario is explained via a Flash animation in German).

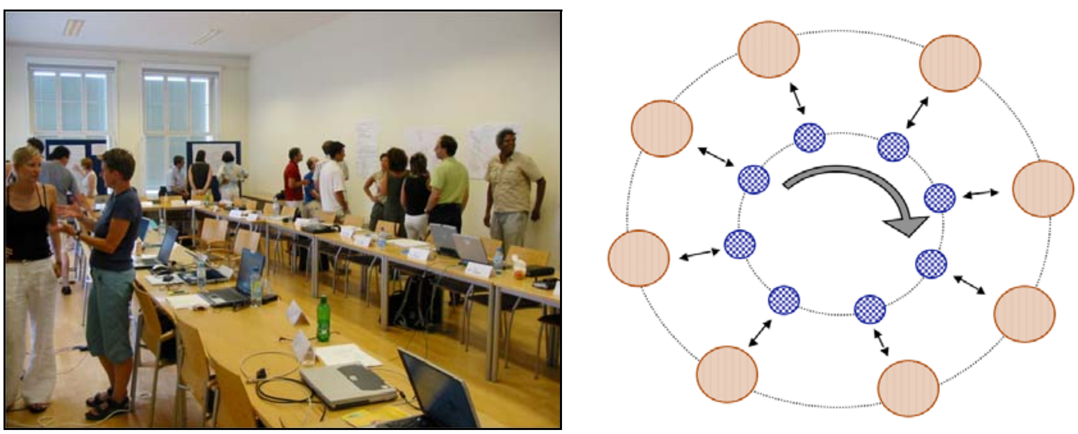

Figure 7: Students at DUK performing the Educational Scenario “Ball Bearing”

7.3 Educational Scenarios link Activities and Curricular Blocks

In our model, the position of the Educational Scenario within the hierarchy (cp. Figure 6) is similarly central as the role of the Learning Target inside the Learning Object: just as the LT connects content (IO) and activity (ES), so concatenates the ES activities on a lower level (we have called this level “Interactions”) with content of a higher level (we have called this “Content Block” or you may say “subject block” as well). The work on a taxonomy of Educational Scenarios therefore has similar importance as it has for the Learning Target. Whereas the taxonomy of Anderson & Krathwohl (2001) offers an approximation for structuring learning objectives, we are still lacking ground breaching works for a taxonomy of Educational Scenarios.

Educational Interactions (cp. Figure 8) are so basic (small), that they do not necessarily incorporate conditions like social and physical parameters. For the interaction of posing a question, which may or may not be interesting to an audience, it is quite enough to formulate this question. To get the audience really involved, we need some additional considerations: What kind of social, spatial and chronological setting is expected? For Educational Scenarios, in contrast to the lower level of Interactions, exactly these environmental factors are essential.

On the other hand, the conceptional design of Educational Scenarios takes place on an abstract level. Educational Scenarios describe circumstances and activity patterns, but they do not require for their design the orientation to a specific content matter.

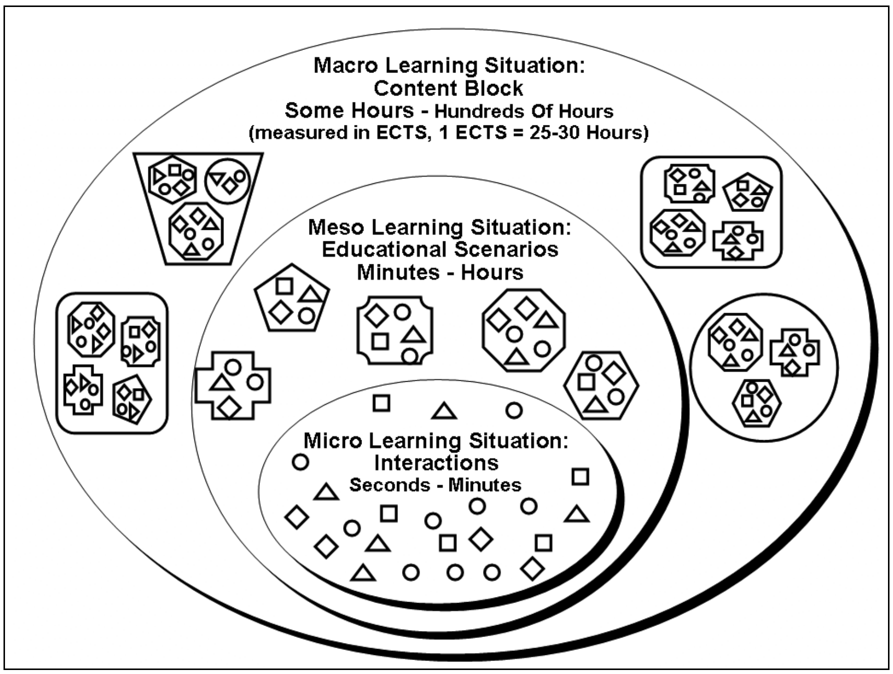

Figure 8: Hierarchy and Granularity of Learning Situations

The configuration of smaller parts such as educational Interactions (cp. Figure 8) into meaningful patterns (the patterns then comprise the Educational Scenarios of the higher level) is in our point of view essential for the philosophical assumption of a hierarchically ordered reality (Baumgartner & Bergner, 2003). Every layer consists of certain kinds of objects, whose belonging to the layer is determined by their granularity. Each higher layer is then constructed in an organized way by the objects of the lower layer. The lower level objects are linked together in a special way, which results in a certain organizational structure, a particular pattern. It is exactly this specific organizational configuration, which results in new features at the higher level. These new functions of the higher level are not present as characteristics of the lower level. They are an emergent feature of the higher level.

To exemplify this concept, we look at the configuration of water molecules. Just as you cannot isolate a molecule H_20 (lower level) from the substance water (higher level) and ask, where is the feature "liquidity" of the molecule, so you cannot take out an Interaction and ask where the didactical perspective on this level is. Just as "liquidity" is a high order characteristic of the specific organizational structure of the lower level objects (molecules), so the (higher order) educational trait of an ES is the result of the organizational configuration of the (lower level) interactions. These philosophical considerations on a hierarchically ordered reality are not new (Polanyi, 1962; Hartmann, 1964). We have only taken this perspective and applied it to our problem.

8 Consequences of the proposed Learning Object Model

We have seen that our proposed Learning Object model provides insight into the relationship between Information Objects and Educational Scenarios. These two parts are linked via the Learning Target, and the relationship can be determined by applying the taxonomy of Anderson & Krathwohl (2001). Some of the consequences of this Learning Object Model are portrayed in the following sections.

8.1 Two different kinds of Repositories

Our proposal assumes that the Learning Object is a combined object. In order to attain the highest degree of reusability, we have to redirect our attention from the Learning Object itself to its constituent parts. We may then think of two different repositories (databank storage systems): One contains a collection of different Information Objects and the other is an archive of different Educational Scenarios. From an educational perspective, we have to decide on a specified Learning Target for a certain subject under specific conditions (social, spatial, chronological, target audience etc.). This setting will in turn determine what kinds of IO and ES are required.

Before the introduction of our Learning Object model, there would have only been one repository in place: the one for Learning Objects. Figure 9 visualizes this consideration.

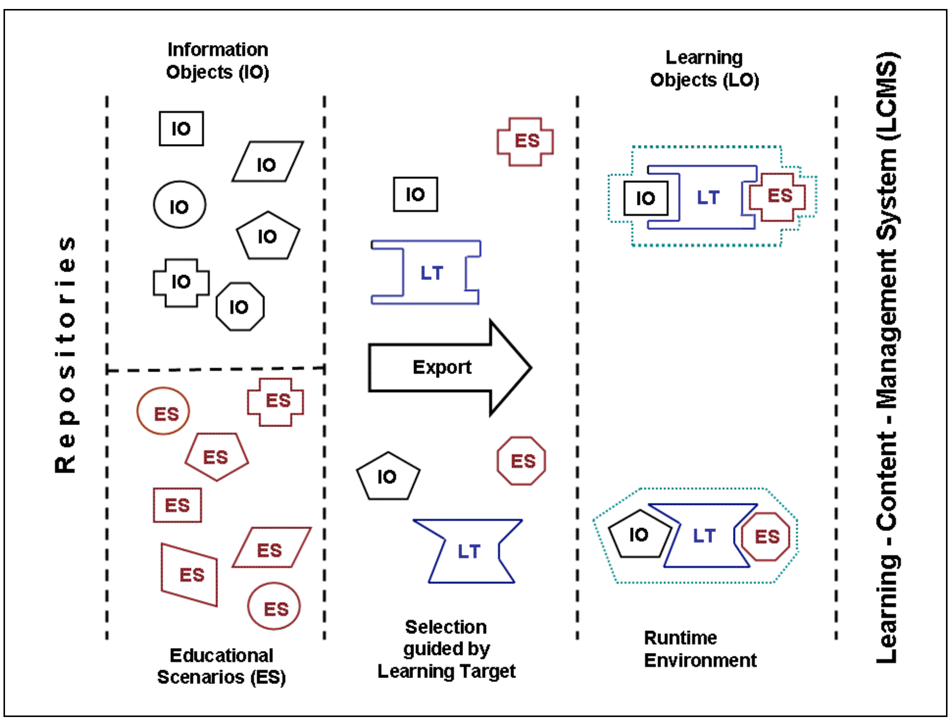

Figure 9: Integration of IO and EO during runtime, guided by the chosen Learning Target

If the user first specifies a learning objective and is able to classify this learning objective according to the Anderson & Krathwohl taxonomy (2001), then an internal process, for instance inside a repository, could suggest Information Objects and Educational Scenarios that match the categories inside the taxonomy, into which the learning objective was classified. Of course, the suggestion of corresponding Information Objects would require additional data, such as a knowledge ontology or user preferences that were stored in a personal profile. Upon the time of request, this data could be retrieved in order to suggest suitable Information Objects and Educational Scenarios.

8.2 Metadata: Taxonomy and Folksonomy Approach

To implement this model of Learning Objects as described herein, another requirement that results from the approach is that specific metadata needs to be assigned to the three components inside the Learning Object. Only through the help of metadata are we able to provide the corresponding matching mechanism just described. The following metadata are needed for the description:

- Information Objects: Metadata that expresses the knowledge type
- Educational Scenarios: Metadata that expresses the cognitive process
- Learning Objectives: Metadata for both knowledge type and cognitive process.

There are problems to be expected when implementing this rigid metadata schema. First, the knowledge type of an Information Object may change depending on the context that it is being used in Dostal, Jeckle, Melzer, & Zengler (2004). Second, different users (instructional designers, teachers etc.) may have differing opinions about the "correct" categorization of an item, but within their specific contexts, the individual categorizations may still all be meaningful. Reacting to this circumstance, we propose another kind of approach, where teachers report their actual usage of the objects by "tagging" [W005]. Instead of having experts index the information or learning objects once in advance, we need a folksonomy approach, where users tag the objects (Information Objects, Educational Scenarios, Learning Objects) according to their experiences.

8.3 IMS Learning Design Implications

If the model for Learning Objects were implemented as put forth in this article, certain influences and consequences are to be expected, among them consequences on the technical specification IMS Learning Design (Koper, Olivier, & Anderson, 2003b).

IMS Learning Design is a tool to model all different kinds of educational scenarios as it is said to be pedagogically neutral (Koper, 2001). Yet, this "all-around" tool does not help us in choosing the right educational model for the intended learning objective in a specified context.

> „The development of a framework that supports pedagogical diversity and innovation, while promoting the exchange and interoperability of e-learning materials is one of the key challenges in the e-learning industry today. The absence of agreed and compatible ways to describe teaching strategies (pedagogical approaches) and educational goals is a constraint that will hold back the development of the industry." (Koper, Olivier, & Anderson, 2003a).

This statement was exactly the reason for our explorations into the inner dynamics of the Learning Object model. If we are able to define a taxonomy of Educational Scenarios to use in Learning Objects, the place to integrate this taxonomy would be the classification element of the IMS metadata specification: purpose and taxonpath (Barker, Campbell, Roberts, & Smythe, 2006). The IMS learning object (our Information Object) could thus be related to IMS activities (our Educational Scenarios) via the use of learning objectives (our Learning Targets, cp. Figure 10).

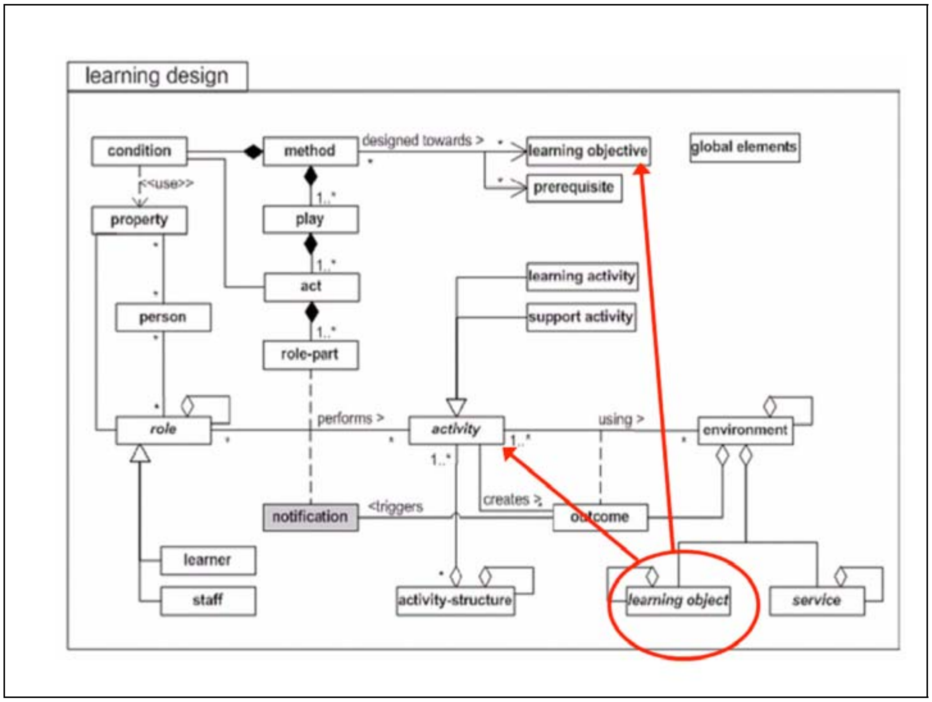

Figure 10: Integration of a Taxonomy of Learning Scenarios into IMS Learning Design (adopted with slight modifications from Koper et al., 2003b)

Each Educational Scenario could function as a template for the complicated procedure of getting all the different parameters into an IMS Learning Design editor. This would be helpful and could speed up the design process as McAndrew, Goodyear, & Dalziel (2006) have also noted.

9 Outlook

In this article, we proposed a model for Learning Objects, whose essence is derived from the separation of content, teaching and learning activities as well as learning objectives. We explored this model under different aspects. One of the main results of our argumentation is that reusability has to be designed not on the level of Learning Objects, but one level below (deeper). We may distinguish between reusable Information Objects and reusable Educational Objects (= Educational Scenarios).

Our proposed model for Learning Objects has consequences regarding the kinds of repositories required for the storage and retrieval of the LO components, on the required metadata as well as on the approach to retrieve metadata. This approach towards a Learning Object is currently being implemented in the repository developments of the project CampusContent [W003].

To improve the reusability of Learning Objects, further investigations into the inner mechanics of its different parts are necessary. Especially a taxonomy of Educational Scenarios – implemented as an archive of different educational methods – could be a seminal step into the advancement in (e)learning theory but also for the daily work of educational practitioners.

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