COMBINING LEARNING DESIGN TEMPLATES

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SUMMARY

Contribution deals with learning design templates combination and overlapping and describes some important ideas behind our concept and methodology of multidimensional, layered and template based educational courses creation that increases reusability. In context of templates combining we illustrate application of Object Constraint Language (OCL) for precise templates modeling and specification. We deal with concrete example which transforms template from the structural to behavioral view and joins it within two-dimensional template covering role aspects. Described methodology allows instructional design of complex learning courses for existing environments and Learning Management Systems compatible with the ADL Shareable Content Object Reference Model (SCORM) and IMS Learning Design (LD) specifications.

***Keywords**: learning design templates, activities, roles, layers, dimensions, learning management systems, SCORM, IMS LD*

1. INTRODUCTION

Design of complex learning courses and instructions requires open concept with methods and methodologies that take into account the maximum number of existing learning aspects as well as the latest standards and specifications in the field of eLearning. Creation of eLearning courses becomes to be a process of designing instructions and resources of Learning Management Systems (LMS). For the faster design it is very important to have the possibility to reuse existing fragments and elements. It is also very helpful to be able to use teaching, learning and collaboration techniques designed by professionals involved in these areas. Within this context we try to bridge the gaps between different worlds of specialists in the areas of teaching, management, standardizations, software and many others.

Our designed methodology is based on the concept of templates described below in more details.

2. LEARNING DESIGN TEMPLATES

Concept of templates could be compared with the concept of design patterns. From this point of view we can consider so-called Learning Design Templates (LDT) or Learning Design Patterns (LDP). Any template or combination of templates can be overlaid on or combined with other templates, creating a more complex instructional strategy. Need for concept of templates in the field of eLearning and some basic design approaches and issues have been presented e.g. in [1],[2],[3],[4].

Structural and behavioral templates can bring certain generality into course sequencing and control design. Similar type of generality and specificity can be found in the inheritance concept in object-oriented approaches between more general parent classes and their more specific child classes. More general template elements can be then reused for specific solutions by mapping on or definition of concrete conformable objects and properties.

An example of simple structural template (T_1) for activity layer written in notation on the base of UML (Unified Modeling Language) can be found in Figure 1.

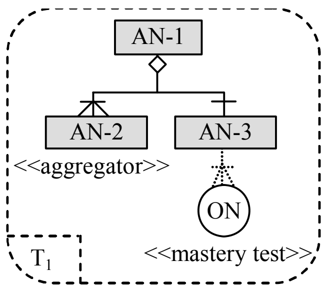

Fig. 1 Example of continuous structural template

Reusable T_1 describes topology and hierarchy of several types of activity nodes (AN) and learning objects nodes (ON). ANs and ONs represent abstract nodes – stereotypes that are while template usage mapped into real objects with defined properties. This process resolves in so called Template Instances (TI). TIs are built on combined and overlaid templates with continuous structural templates where all structural nodes and elements model continuous and usually hierarchical structure. As shown in Figure 2 depending on the defined conditions each AN from a template can be in TI replaced with concrete Learning Activity/s – LA and each ON with concrete Learning Object/s – LO.

This concept also includes discontinuous templates where the nodes and elements can be distributed into structural modules not directly associated with aggregation (there are usually dependences between such a modules).

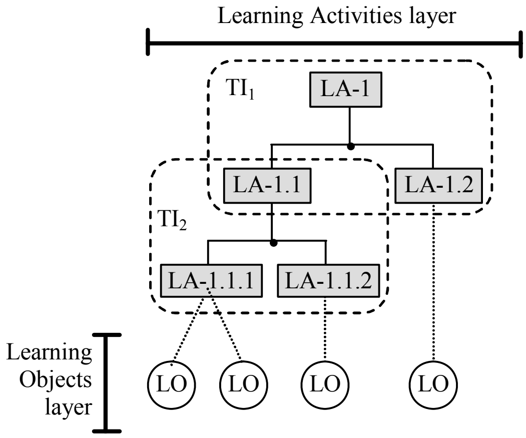

Fig. 2 Example of template instances in design layers

3. MULTIDIMENSIONALITY OF TEMPLATES

Variety of specifics and attributes accepted during course and learning control design (roles, objectives, artificial intelligence and schedule based sequencing, learner competency and progress affected or customized learning, assessments, etc.) [8] can increase complexity of these processes. They could be considered as node or object attributes in some layer but they can also be designed in separate layers as illustrated in Figure 2. Binding (Joining) of the layers can be provided on the level of instances as well as on the level of templates what is preferred in our approach. Some of the layers are formed in existing specification like IMS Learning Design (IMS LD) [6], ADL SCORM (Shareable Content Object Reference Model) [5], etc.

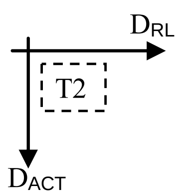

Fig. 3a Dimensions modeled by template T_2

Depending on the type of learning aspects modeled by templates some of the design layers introduce new dimensions [9]. From multidimensional point of view the IMS LD specification covers the role aspects that in context of LAs (modeled in the D_{ACT} – Dimension of Activities – figure 3a) represent a non-collinear layer of new dimension (D_{RL} – Dimension of Roles). Then in our concept most of the learning aspects can be used in terms or layer as well as dimension depending on the need to model a point of view that affects another aspects or not. By affecting we indicate in this situation the ability of modeled learning aspect to be in a conditional statement which can result in changing of activities flow (activity in general, not only learning activity).

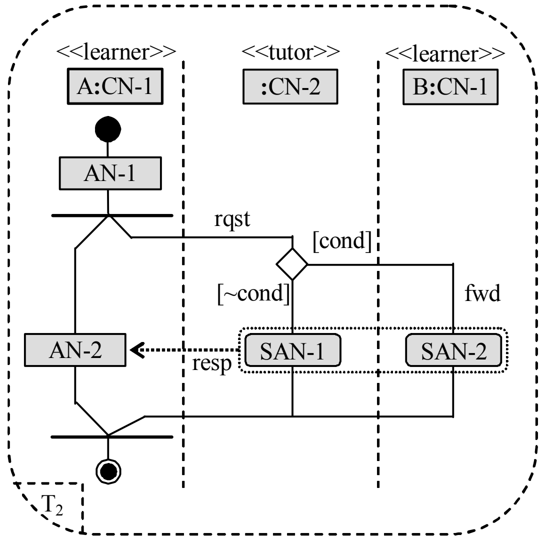

Fig. 3b Example of two-dimensional structural template

T_2 in figure 3b supports 2 instances (A and B) of collaboration node (CN-1) that represents stereotype – learner. Let a learner A require (rqst) support. Assuming that specified conditions ([cond]) are not broken a tutor delegates (fwd - forwards) required task to the appropriate learner who has needed level of knowledge and is able to provide this support (SAN-2). Otherwise ([~cond] – e.g. no learner is available at that time or no competent learner is available etc.) tutor has to perform support activity (SAN-1) by him/her-self.

In other words we can illustrate it on an example of fragment of some collaborative learning environment. Student (in the role of learner) works with some parts of online course represented by activity AN-1. After he has finished this part he can decide for extra support (e.g. detailed descriptions, unclear parts discussion etc.). LMS system at this point offers request for support directly to someone who plays the role of tutor (teacher, lector, etc.). Depending on situation (results from some tests, speed of learning, skills level, etc.) tutor decides who can realize support (someone in the role of learner different from the one who requires it). After support phase (AN-2 of learner A in parallel within the SAN-1 or SAN-2 as support activities) has finished LMS comes back to control master flow of learner A.

4. COMBINING TEMPLATES

Methodology of template based learning design distinguishes the following main techniques in templates (template instances) combination:

1. Single Join (SJoin)
2. Overlapped Join (OJoin)

The difference between both joins is described in the following simplified definitions:

$$Join: T_i \oplus T_j \xrightarrow{COND_{JOIN}} T_z$$

Where T_i, T_j are source templates; T_z is target created template; $i, j, z \in N$; $i, j \neq z$ and $COND_{JOIN}$ represents join conditions defined as set of conditions for nodes ($COND_N$), transitions ($COND_T$) and template constraints ($COND_{CONSTR}$):

$$COND_{JOIN} = \{COND_N, COND_T, COND_{CONSTR}\}$$

Let N_i be a set of T_i structural nodes and $n(N_i)$ is number of elements included in set N_i, $i \in N$. If all $COND_{JOIN}$ (pre-conditions) are satisfied then the required post-conditions for elements number in case of SJoin and OJoin written in OCL (Object Constraint Language) notation are:

context

$Template :: SJoin(T_i, T_j : Template) : Template$

post:

$n(N_Z) = n(N_i) + n(N_j) - 1$

context

$Template :: OJoin(T_i, T_j : Template) : Template$

post:

$n(N_Z) < n(N_i) + n(N_j) - 1$

$\max(n(N_i), n(N_j)) \leq n(N_Z)$

In other words, SJoin represents simple combination of templates where exactly 1 structural node defines junction point. OJoin requires overlapping of 2 or more structural nodes. Analogously to described templates combination, we have defined the process of template instantiation while using templates for existing structure of template instances.

Some of the structural templates can be specified also from the dynamic view and then used for combination with other dynamic templates. Figure 4 illustrates T_1^D as dynamic representation of T_1 independently from the dimension of roles. This dynamic representation we create from T_1 as the transformation:

$$DynT : T_i \longrightarrow T_i^D$$

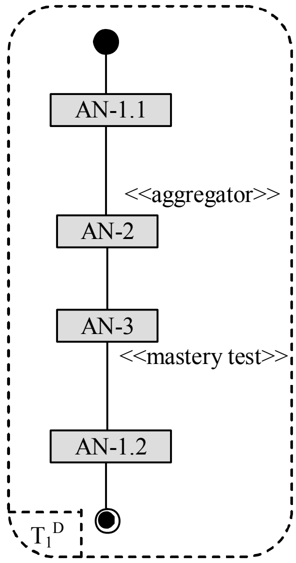

Fig. 4 Dynamic view of structural template

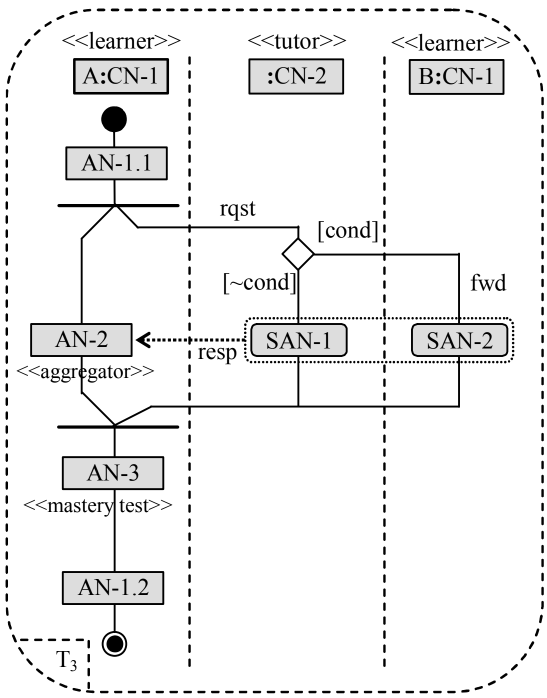

Fig. 5 Example of two-dimensional combined template

Figure 5 represents example of T_3 created as T_2 overlapped by T_1^D with the following junction nodes mapping:

$$T_1^D \oplus T_2 \longrightarrow T_3$$

$$AN-1.1 \oplus AN-1 \longrightarrow AN-1.1$$

$$AN-2 \oplus AN-2 \longrightarrow AN-2$$

CONCLUSION

The illustrated methodology of learning design templates allows sequential step-by-step design and creation in separate layers of specific dimension. Each single-layer then consists of a collection of grouped or overlapped templates that can be bounded with or mapped into another layers of the same or different dimension. In the first step this process resolves in a learning skeleton that can be in the second step precisely specified (parameters and attribute values), completed with concrete learning elements and aspects. Depending on the requirements, which concern meeting the appropriate level of variety, designers need the possibility to add new elements and nodes that are not directly included in the templates of the already created skeleton. Therefore our concept allows and also suggests adding of non-templated learning elements in the final designing phases.

Presented concept itself, and some of the design tools based on it, have been already developed at our department. Our design tools also include set of predefined templates that can easily be extended with new customized templates.

With the learning design templates we plan to follow the ideas of global structred repositories with precisely defined metadata as it is in the case of learning objects.

Because of the ideas of multilayered and multidimensional design included in our concept we plan for the later phases to add some ideas from multidimensional databases and OLAP cubes.

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BIOGRAPHIES

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