On Using Workflow Technology to model eLearning Process

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Abstract

eLearning can be viewed as a coordination of dependent learning activities in an online setting. During the last two decades, workflow and related technologies have delivered successfully in the area of activity coordination, although primarily in the business domain. However, there is evidence in literature that the principles of workflow management have been successfully utilized in the eLearning domain as well. In this paper, we present a brief analysis of various classes of dependencies that can exist in eLearning processes. We will demonstrate the overlaps and differences of these dependency classes with conventional process modeling aspects.

1 Introduction

During the last two decades, workflow and related technologies have delivered successfully in the area of activity coordination, although primarily in the business domain. However, there is evidence in literature that the principles of workflow management could benefit the other domains as well.

Flex-eL [1, 2] utilized workflow technology to facilitate personalized activities sequencing by using the structural aspect of workflow specification to model online courses. Kong [3] introduced formal definition method of workflow-based courses using fuzzy Petri nets, then proposed a workflow based elearning architecture by utilizing workflow technology and learning object services.

Merko [4] defined course as a workflow to exploit powerful procedural rules to define precise but yet flexible learning paths. Xiao [5] proposed meta-data structure to make a base model for reusing and aggregating learning resources and utilizes high-level Petri net for aggregation model.

We have observed the two main commonalities between these works. First, it is the use of structural aspect, specially the basic control flow patterns [6], to model the sequencing orders of elearning activities. Second, we have not found any discussion about the other types of dependencies that may arise in the real world elearning. We argue that there are other types of dependencies that can be associated with elearning activities to ensure quality learning, and thus must also be captured to obtain a "good model".

Our main motivation in this paper is to explore these other types of dependencies that may arise when modeling elearning activities. Then to investigate, if any, modeling limitations of the structural aspects when considering these dependencies.

The paper is structured as follows. A brief introduction of elearning activity and its dependencies are discussed in Section 2. We then discuss possible obstacles and difficulties of modeling elearning activities based on the structural aspect of workflow specification in the Section 3. Last, in the conclusion, we address issues that must be considered further when using the workflow specification to model elearning activities.

2 eLearning Activity

We begin by defining elearning activities as activities that are used to educating or instructing learners online. We organize these activities into three different levels of granularities. This decision is based on our abstraction of the pedagogical utilized in the traditional educational environment.

We call the lowest and the smallest level of elearning activity, which are also the building block of all larger elearning activities, as *Learning Module*, LM. We categorize these LMs into two main types: 1) study or 2) exam activities. Study activity is an activity that learners are asked to read, observe, or research a given set of learning material while the exam activity is an activity that learners are asked to demonstrate impart knowledge or skill through a set of questions or exercises.

The second granularity level is called eCourse. We define an *eCourse* as a set of LMs that are selected and struc-

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tured by the expert around identified learning needs, and have explicit learning objectives. The third granularity level and the largest set of elearning activities is *eProgram*, which is defined as a unique set of eCourses that are selected and structured by the expert around identified and explicit learning objective.

The manner in which these elearning activities are selected and structured must be designed by the subject experts. However, once they are selected and structured, these elearning activities are said to have some types of dependencies between them. Based on how these elearning activities can be selected or structured, we categorize these dependencies into three main types of dependencies as: 1) Membership dependency, 2) Ordering dependency, and 3) Performance dependency.

2.1 Membership Dependency

Given a much broader educational scope, a systematic modeling approach in which elearning activities can be selected and structured to compose a larger granularity could be very useful. One such systematic approach can be achieved through the concept of membership dependency. When one or more elearning activities are selected to create a larger granularity, it is said that there exist membership dependency between them.

One approach is to assigned membership dependency such that one group of members is a set of activities that learners are free to choose while the other group of members is those activities that are strictly prescribed. We categorize members in any give set of elearning activities into two types: 1) Compulsory, and 2) Elective.

Compulsory: An activity or set(s) of activities can be assigned as the compulsory activities set(s) where learners must passed them in order to complete the requirements of a particular learning objective to be met.

Elective: An activity or set(s) of activities can be assigned as the elective activities set(s) such that learners can choose to enroll, which, when added to the compulsory set, enable requirements of a particular learning objective to be met.

2.2 Ordering Dependency

In this section, we introduce two types of the ordering dependencies. The first involves the structural sequences while the latter involves both the structural and the temporal sequences. We call these two types of ordering dependency as: 1) Prerequisite dependency and 2) Corequisite dependency.

Prerequisite: An activity or set(s) of activities can be assigned as a set of prerequisite activities, which must be completed before for another activity(s) or set(s) can be enrolled. Thus, learners should only be allowed to enroll in elearning activities that he/she has passed, has been granted credit for activity(s) or set(s) of elearning activities listed as prerequisite of the activities.

Corequisite: An activity or set(s) of activities can be assigned as a set of corequisite, which are required to be taken simultaneously with another. Consequently, learners should not be enrolled in the elearning activities unless the learner has passed, has been granted credit for, or is concurrently enrolled in any activity listed as theirs corequisite.

2.3 Performance Dependency

In this part, we introduce two types of performance dependencies as: 1) the Score base and 2) the Temporal based dependencies.

Score Based: An activity or set(s) of activities can have some manners of the score based dependencies associated with. For example, learners must achieve minimum exam score of 80 % on a particular exam activity before they are allowed to participate.

Temporal Based: An activity or set(s) of activities can have some form of the temporal dependencies associated with. For example, learners might be required to finish a particular LM with in a given deadline.

A number of dependencies that can be utilized in the real world situation were introduced in this section. Note that while there are many variants of these dependencies, most if not all can be categorized under one of the introduced category. Furthermore, we believe that the introduced dependencies are well adequate to represent the real world applications as they are abstracted from the real world situation.

3 Obstacles and Difficulties

The first difficulty involves the modeling of the corequisite dependency. The problem is that the use of structural aspect of the workflow specification to model corequisite dependencies, which are often associated with time value might not be a sensible approach given that the controlflows patterns do no offer any sensible constructs that can be utilized to specified time value. Note that we follow the basic notations used in [7]

The second difficulty involves the structural verification across these granularities. We have identified two basic pedagogical verification problems: 1) Inconsistent and 2) Redundant dependencies.

Inconsistency dependency It is a common practice to reuse LMs, and thus it is naturally to have two or more eCourses with some overlapped activities. In another words, there exists subset(s) of activities between these eCourses. The problem arises when the two or more overlapped eCourses have specified dependencies that are pedagogical inconsistent with the others. For example, in one eCourse, an LM might be assigned as an elective LM but the same LM in the other eCourse is assigned as a compulsory LM.

Redundant dependency

Giving that it is normal practice to reuse these activities, it is also possible that there can be a number of excessive dependencies with in a given elearning process. For example, two eCourses, e_7 and e_8, where both eCourses have specified lm_{27} as one of the compulsory activities. The problem arises when these two eCourses are connected through a prerequisite dependency (e_7, e_8) on the same process. Figure 1 illustrate a situation where both e_1 and e_8 are used to compose an eProgram,p_1.

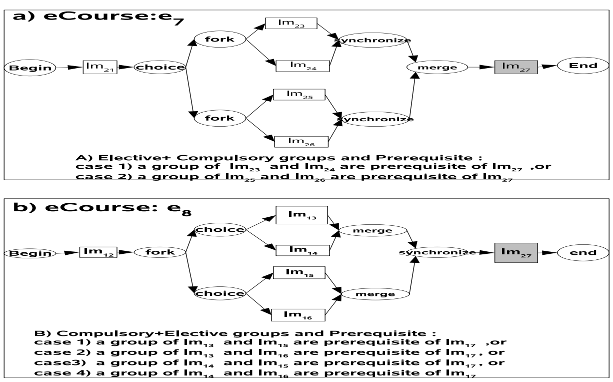

Figure 1. Redundant LM of eCourses e_7 and e_8

Again, we have observed that a quick glance at the prerequisite dependency specifies on p_1 as (e_7, e_8) would not reveal any dependency problem. However, when we examine at the lower granularity i.e. at the eCourse granularity level, we found that they are introducing redundant dependency where lm_{27} should have been completed in e_7 but it is again required to be completed in e_8.

Note that thus far, we have been using a rather simple set of elearning activities to illustrate the discussion. However, in the real world applications, a set of elearning activities usually involves a much more complex patterns of dependencies specially when considering personalized elearning support.

4 Conclusion

The main focus of this paper is to present dependencies that are utilized in the real world to ensure quality of learning. We have investigated the modeling of these dependencies using the structural aspect of process modeling as used in workflow systems. As such we have identified the number of problems that can arise when modeling such dependencies using the structural aspect.

We envisage the following issues that must be investigated further. First, the possibility of extension of control flows constructs to support the corequisite dependency. Second, the integration of the structural aspect i.e. control flow, the temporal aspect, and the data aspect of the workflow specification to model elearning activities. Third, a systematic approach for pedagogical verification of an elearning process

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