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Semantic Description of Collaboration Scripts for Service Oriented CSCL Systems

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Abstract. Many CSCL systems have embraced scripting and service oriented computing to achieve effective collaboration and system flexibility, respectively. While learning standards, such as IMS-LD, can be used for scripting, we have encountered some problems to describe activity types, their collaboration properties and learning tools with this standard. The usability of collaboration scripts is limited, since some important features cannot be described. Furthermore, poor description of tools hinders the search of tools, offered as services, in service oriented CSCL systems. To overcome these difficulties, we propose an ontology that can be used to enrich the description of activities and tools in a script. Besides, the authoring process of a learning design is eased due to enforced restrictions in the ontology as well as the use of off-the-self ontology editors. Furthermore, formal and explicit semantics in a script can be exploited to automate the search of tools. This way, service providers can describe their tools in terms of the ontology, while educators can search for them using domain concepts.

1. Introduction

CSCL systems can be benefited both from *scripting* and *service oriented computing* [6]. "Scripting is a means to enhance the effectiveness of collaboration by prescribing how students should form groups, how they should interact and collaborate and how they should solve the problem" [3]. Scripts can be interpreted by systems in order to manage the sequence of activities to be performed by learners. Services can be employed in order to provide the software tools required to support a learning experience. An example of a CSCL system that adopts scripting and the service oriented approach is Gridcole [1]. It can be used as follows: learning designers can build their own scripts to model their educational scenarios. Next, a script interpreter will validate the script and arrange the sequence of activities. Then, external resources and tools offered as services needed to support the scenario described in the script will be discovered and integrated. Finally, users will join the resulting set up.

Developing such a system involves many challenging issues. First of all, an *Educational Modelling Language* (EML) is needed to formalize the collaboration scripts, so that it can be unambiguously interpreted. This way, a script player could manage the flow of activities to be performed in an educational system, as well as the arrangement of needed learning resources. The IMS Learning Design (IMS-LD) specification is, perhaps, the most relevant and complete EML for e-learning. Interestingly, it can be used to describe collaboration scripts although with some restrictions [5].

A collaboration script comprises a flow of activities that can be performed individually or collaboratively. Each activity is supported by a set of learning resources of two types: tools and contents. Although the IMS-LD model uses these abstractions, we have encountered some difficulties when using IMS-LD to formalize collaboration scripts. First, *activity types are not defined*. Each activity type, e.g. an edition or a debate, has some distinguishing properties, such as specific outcomes and roles, that should be identified in a collaboration script. Since authoring a learning design is an error-prone and time-consuming task, an authoring system could embed this information to support the user when authoring a design. Second, *collaborative activities cannot be properly described* [5] because IMS-LD provides no means to specify how individuals collaborate within each activity. This is critical to state how learners should interact to perform a collaborative activity. A third issue is *the description of learning tools in a script*. IMS-LD can integrate descriptions of learning objects in a learning design using standards such as IEEE LOM or the service elements included in the IMS-LD specification (e.g. a conference). However, only a limited set of tools can be specified, as standards of learning objects do not even define a vocabulary of learning tools. On the one hand, these problems reduce the expressiveness of col-

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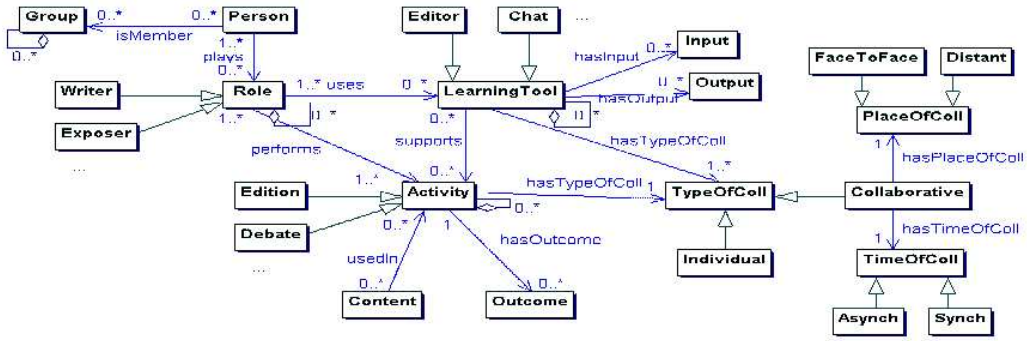

Figure 1. Conceptual model of an ontology of activities and learning tools. Core concepts are roles, activities and learning resources. The description of activities is decoupled from the description of tools and contents to achieve enhanced flexibility in the design.

laboration scripts precluding usability in educational scenarios and script sharing, since significant information cannot be expressed. On the other hand, poor description of learning tools severely limits automated discovery of appropriate tools, offered as services, to be integrated in a service oriented CSCL system. If learning tools were properly described in a learning design, a computer agent could support the discovery of suitable services. Otherwise, an educator should manually search for learning tools, reducing the usability of such CSCL system.

To overcome these difficulties, a collaboration script should better describe learning activities with meaningful information about activity types and collaboration features. Furthermore, describing the required learning tools to support a collaboration script would ease the binding of specific tools during the enactment of the scenario. In his sense, an ontology could be employed to capture the semantics involved in the description of learning activities and tools. Ontologies [2] are used to explicitly formalize knowledge in a shared manner, enabling rich descriptions and robust information retrieval systems. Thus, in this paper we propose an ontology that can be used to enrich the description of the activities and tools involved in collaboration scripts, while easing the authoring process. Besides, in a service oriented learning system tools offered as services can be searched using the learning abstractions described in the ontology. In previous work we analysed current service discovery mechanisms and proposed the use of educational ontologies to ease educators to search for learning services using their own terms [7].

In section 2 we describe an ontology that can be used to enrich the description of activities and learning tools involved in collaboration scripts. Section 3 illustrates the application of such ontology in a collaborative learning scenario. Finally, the main conclusions are shown.

2. Describing Collaboration Scripts with an Ontology of Activities and Learning Tools

IMS-LD has some important limitations to describe activities, specially collaborative activities. Besides, it is difficult to specify the tools required to support an activity. These facts limit the expressiveness of learning designs as well as the search of appropriate tools by educators. Both issues can be tackled by the semantic annotation of the activities and tools included in an IMS-LD-compliant script. An ontology can be employed to formalize this required knowledge with explicit semantics which can be easily shared and it is interpretable by the learning infrastructure.

A feasible model of such an ontology is shown pictorially in figure 1. The problem of specifying activity types is tackled defining a set that can be applied to a broad range of collaboration scenarios, such as *Debate* an *Edition*. Second, collaboration capabilities defined at activity and tool levels can be expressed using this ontology. The well-known categorization using time and space [4] is employed here. Finally, learning tools such as *Editor* or *Chat* can be described using the educational abstractions modelled in the ontology.

3. Application in a Collaboration Learning Scenario

To illustrate the application of the proposed ontology, a simple collaborative scenario based on the well-known "snowball" collaboration pattern is described using the ontology abstractions, shown in table 1. Although this script can be formalized in IMS-LD, problems detected in section 1 should be addressed in order to enable the actual realization of the scenario. This way, a semantic description of the involved tools and activities is provided and can be attached to the IMS-LD script to enable the unambiguous interpretation of the script.

While service oriented computing advocates increased flexibility and reusability to deliver software, it introduces the problem of discovering appropriate services in order to realize such systems. In the case of service

Table 1. Description of a sample collaborative learning scenario. It comprises three sequential activities: A1 consists on reading a document, in A2 learners must individually respond to a questionnaire about the document, while A3 depicts a collaborative debate in which participants have to agree to a common response. These activities, as well as the contents and tools that support them, are described using the abstractions modelled in the proposed ontology, shown in figure 1.

Activity					**Content**		**Tool**					
Ref	**Type**	**Collab**	**Roles**	**Outc**	**Ref**	**Roles**	**Ref**	**Type**	**Collab**	**Roles**	**In**	**Out**
A1	Studying	Indiv	Learner	-	D1	Learner	T1	Viewer	Indiv	Learner	D1	-
A2	Assessment	Indiv	Submitter	D3	D2	Submitter	T2	Questionnaire	Indiv	Submitter	D2	D3
A3	Debate	Collab Sync Distant	Debater Submitter	D4	D2	Submitter	T3	Chat	Collab Sync	Debater	-	-
					D3	Debater	T4	Viewer	Indiv	Debater	D3	-
							T5	Questionnaire	Indiv	Submitter	D2	D4

oriented CSCL systems, educators are usually in charge on setting the arrangement of the scenario, including the search of tools. They should be capable to perform this search in a convenient way. Therefore, educators could use the educational abstractions formalized in the proposed ontology to search for tools if providers commit to this ontology. An extensive discussion about this topic is offered in [7].

In the depicted scenario, a computer agent can interpret the semantic tool descriptions in the script (tools *T1* through *T5* in table 1) and query registries of learning tools for the providers descriptions. Educators can use the encountered tools or begin a new query using the ontology concepts.

4. Conclusions and Future Work

Current educational standards for scripting have some limitations to describe collaboration scripts. The ontology proposed in this paper overcomes these problems enabling the semantic description of these features, while still conforming to existing standards, such as IMS-LD. This way, educational scenarios can be deeply described allowing for enhanced usability, since the underlying learning infrastructure can take appropriate actions to enact the scenario. Besides, semantic description of tools and activities can be exploited to automate the search of tools, offered as services, in a service oriented CSCL system.

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