A Generic Specification of the Data-Flow Issue in the Learning Design Field

* Scenario Team, University of Savoie, France
** GSIC-EMIC Group, University of Valladolid, Spain

laurence.vignollet@univ-savoie.fr
{migbot, juaase, yannis@yllera.tel.uva.es}

Abstract

Many studies show the advantages of using a learning design approach to help teachers and instructional designers to create technology enhanced collaborative learning activities. However, some of these studies highlight lacks in such approach. This paper addresses one of them: the representation of the flow of data in the learning activity models. A generic specification is proposed that aims at pointing out the conceptual needs that should be taken into account in the languages to improve the approaches.

1. Introduction

Learning design (LD) languages have shown their expressiveness while modeling various types of e-Learning collaborative activities [1]. However, some studies have highlighted some lacks, considering in particular the modeling of the flow of data [2] [3] [4] [5]. These studies have shown that there is a need to represent this flow between activities, tools and between both. However, none of them is giving a complete view of what is missing.

The goal of this work is to give a clearer view of what data-flow refers to in the LD field at the design stage. This work aims to improve the models of e-learning activities by defining the conceptual needs to represent the flow of data and by proposing a general way to model it. The richer the model, the more support might be expected from the associated environments.

2. A general view of the data-flow

2.1 Some vocabulary

An activity is ‘what is going on’ in the common sense. Here, activity does not refer to any concept of any LD language. An activity is specified by a learning design. A learning design is the codified and formal description of a future activity, expressed using a learning design language. A resource is either an artifact or a tool used in an activity. An artifact refers to a document or to structured data. Finally, in that context, the data-flow in the LD field does not refer to the well-known “data-flow programming” field.

2.2 The “data-flow problem”

Several studies have already addressed the data-flow issue either directly or indirectly. We can find three types of studies that focus on the data-flow between tools and activities, or between just activities or just tools.

2.2.1. Data-flow between tools and activities. A previous work refers to the use of exercises within an activity [6]. Usually, exercise and activity are linked through the answer(s) to the exercise(s), provided by the participants, and therefore, the activity may be affected by such answers. Considering the IMS LD approach, IMS LD properties and IMS QTI variables are used to represent this kind of link. However, as stated in section 4.1 of [7], the proposed coupling imposes syntactic constraints: property identifiers and variable names lexically identical at design time. Moreover, such a solution only allows capturing the response of the exercise, but more information could be interesting (as the time to answer to a question).

Another example described in [4], points out that IMS LD does not seem to answer to such conceptual needs: “For example, while a flow can be designed using IMS Learning Design that states that a discussion forum should be launched at a particular point within the flow, it cannot be used to determine

\[ \text{We should have used “artifact-flow” rather than data-flow, however, this last term seems to be already accepted in the field of LD.} \]
what the initial threads or topics are that should be presented, or whether the results of discussion should be exported elsewhere."

The LDL (Learning Design Language) approach [8], without directly speaking of data-flow between tools and activities, stresses the importance of such a link. LDL defines two concepts, the observable and the position as the basis for controlling, from the learning activity, the inputs and outputs of the related tools.

In conclusion, there seems to be a wide consensus on the need to model the link between tools and activities. Considering the above studies, it should at least be possible to specify: the tool invocation parameters, the tool or activity state information, the observations of what the participants are doing while interacting with the tool, the learning outcomes of an activity, etc.

### 2.2.2 Data-flow between activities

The data-flow between activities is one of the dependencies between activities. It is exemplified in the example presented in [16]: L. Palomino & al. have shown that with IMS LD, "the user is responsible for managing data-flow". They have illustrated that this is error-prone and generates additional cognitive overload for the users.

J. Dalziel in [5] gives the same requirement to IMS LD: there is the need of "an ability to pass tool information across Acts". In that case, the artifacts (tool information) go from one act to another, and as an IMS LD act will give rise to an activity, J. Dalziel by this way points out lacks of conceptual means to represent this kind of link between two activities.

Y. Miao & al in [3] state that "IMS LD has no notation which explicitly represents the transference of an artifact produced in an activity and consumed by other activities". They give an indirect way using environments and properties. However, they recognize that there is a need of "a high-level representation of coordination mechanism", considering that the transfer of data is one of the coordination mechanisms.

In LDL [8], activities can share artifacts (observables and arenas) and the learning flow implicitly defines the flow of artifacts.

These studies point out some interesting cases where the data-flow between two activities needs to be modelled.

### 2.2.3 Data-flow between tools

In the example given in [2], L. Palomino & al highlight that with IMS LD "the user, not the system, is the party responsible for matching data with tools" because "LD lacks the management of the data flow, since LD has no means to specify the data flow between tools". Their final goal is thus to propose a way to model the data-flow between tools in a workflow-based language, and to synchronise the learning flow and the data-flow. They have shown that the case considered in the previous section could also be solved in this way [16].

J. Dalziel in [5] points out the need of "ways for one tool to pass information to another tool (with possible processing of information in between tools)".

### 2.2. A data-flow model

None of the previous studies are giving a clear and language independent view of what the data-flow is in the LD field. We state that at the design stage, the data-flow corresponds to the specification of the flow of data between an activity and a tool which will support the activity (arrows in dotted line in figure 1) and to the specification of the flow of data between activities (full arrows in figure 1).

![Figure 1: The Data-Flow specification schema](image)

Artifacts “circulate” on the arrows, i.e. are transmitted from an activity to another one or to a tool and vice versa. We can say that an activity or a tool consumes and/or produces artifacts.

We can also make the distinction between three types of flow of artifacts: for invocation (the flow is going from the activity to the tool); for observation (the flow is going from the tool to the activity; if an artifact is produced using a tool, it is considered as a result of an observation of what is produced); for coordination (the flow is going from one activity to another).

The general view does not include a link between two tools. In fact, this link is indirectly taken into account, through the other links. We consider here that, in spite of other kinds of activities (like a game activity, administrative activity, commercial activity, etc.), the progression of the activity has to be observable by all the actors as this observation contributes to the success of learning. Thus, the activity should be aware of all the interactions between the tools. Moreover, LD languages are generally “activity-centered” and not “tool-centered”: This is a position that might be, of course, verified in future studies.
3. The data-flow model applied to the peer-review example

We will consider a basic version of a peer-review activity. The data-flow consists of specifying that the report will be the result of the use of a collaborative editor in a writing activity and that this report will be an input to an analysis activity and therefore, to the collaborative annotation tool.

The data-flow in the peer-review example could be represented as shown in figure 2. The sequence between the writing activity and the analysis one is not represented so as not to get confused with the data-flow arrows. Moreover, this is only an example of what the data-flow could be as other artifacts could be useful in some cases.

Figure 2: The data-flow in the peer-review example

4. Conclusion

The learning design field has first focused on the control flow, called in that case the learning flow. Thus, in the existing approaches, the data-flow is implicit and generally the user has to take it in charge when the activity is performed. Today, as the learning design field becomes more mature, the refinement of its models, languages and tools has started. One of the aspects has been taken into account in this paper: the modeling of the data-flow.

A generic specification, that is to say independent of any model or language, is proposed at a high design level to represent the flow of artifacts in a learning activity. The ambition is that such a specification should help to take it into account in the existing LD approaches. This could consists of adding the “right concepts” to the languages, but also to take it into account into the tools, giving for instance a “data-flow” view in the learning design editors.

5. Acknowledgements

This research has been partially funded by the European Comission (eContentPlus project EDU 427015), Spanish Ministry of Science and Educ. (project TIN2008-03023/TSI) and by the Regional Gov. of Castilla y León (projects VA106A08 and VA107A08).

6. References


