Learning Design Family Tree to Back Reuse and Cooperation

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Abstract

The types of artefacts or solutions used towards the creation learning designs (Learning design Solutions, LdS) are diverse (patterns, course maps, activities, etc.) and have varied or multiple lives. Sometimes designs are created by an individual teacher for a single use with their students. But often, they are reused the following years or by other teachers with minor adaptations. Other times, designs are co-outlined by networks of teacher and later refined by each teacher for their particular group of students, or they are co-designed involving students. These scenarios can imply the creation of multiple replicas of the same design, which in turn may be duplicated and refined as new LdS. In this paper we state that supporting the management and visualization of interrelated LdS can back scenarios of cooperation and reuse in the context of design communities. In particular, we propose an LdS branching model visualized following a family-tree metaphor. We define a "learning designs' family" as a collection of learning designs which weren't started from scratch but by replicating (or duplicating) a particular existing learning design. The model, and its visualization, has been implemented as a new feature in the LdShake teacher-community platform, as part of the Metis Integrated Learning Design Environment (ILDE). The development of the feature consists of two main modules: one devoted to the management of the family-related LdS and another focused on their visualization. On the one hand, the management module is in charge of storing LdS replicas' data, managing their interrelations, and retrieving a learning design family corresponding to a given LdS. On the other hand, the visualization module displays a learning design family as square-shaped icons representing LdSs, and its family-relations using arrows. This first implementation of both the model and its visualization has enabled the collection of the first feedback from learning technology experts. The evaluation was carried out online. 11 experts responded to our invitation to try the feature completing a set of tasks and an on-line questionnaire. Their opinions indicate that the feature is interesting and could significantly address relevant learning design and co-design situations. They used the feature satisfactorily but also pointed out several suggestions to improve its usability and enhance its potential utility. The suggestions are being considered in a second iteration of the model and its implementation, which will be used by teachers in the Metis workshops.

Keywords

Learning Design, reuse, learning design management, visualization, family tree metaphor, teacher communities.

Introduction

The Learning Design field focuses on how to support teachers, networks of teachers and other stakeholders such as academic managers and students as designers and co-designers of technology-supported learning activities according to their specific educational needs and objectives, for example in particular contexts of networked learning (Conole, 2012; Mor, Craft & Hernández-Leo, 2013; Mor & Winters, 2007). Previous research on learning design has provided a myriad of learning design approaches and tools (Persico et al., 2013; Prieto et al., 2013). However, their support to learning co-design situations and processes is limited. Documenting and capturing the design process and design outcomes in learning design is important since it enables the communication and alignment of multiple designers' perspectives and contributions. Besides, resources as design patterns and structured representations can act as scaffolds in design processes involving several designers (Scanlon et al, 2009). However, the management of the documented designs and their representations is also critical when supporting the cooperation among designers. Yet, learning design management can also serve design situations of individual teachers that are not properly solved with the existing tooling (Hernández-Leo et al., 2013; Neumann et al., 2010).

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We use the term Learning design Solutions (LdS) to refer to the diverse types of artefacts or solutions that can be used towards the creation of full-fledged learning designs (patterns, course maps, activities, etc.). Therefore, LdS can be of different levels of granularity and abstraction. Designs and LdSs in general are sometimes created by a single designer for a single use. But often, teachers adapt or reuse their LdS from one year to another doing minor changes to their designs. Besides, practitioners can be part of a design team or networked community focused on the joint development of designs (Hernández-Leo et. al, 2011), where they share designs, comment them, and cooperatively edit their description, content, etc. When implementing the designs with students, particular teachers may refine a jointly created design considering the specific characteristics of their classroom. Students might be also included in the design or refinement process (Könings, Brand-Gruwel &Van Merriënboer, 2011). These scenarios can imply the creation of multiple replicas or duplications of the same design, which in turn may be duplicated and refined as a new LdS.

In this paper we show a system that enables the replication of designs as feature that can serve co-design processes. More specifically, we state that supporting the management and visualization of these multiple replicas can back scenarios of cooperation, co-design and (personal, institutional or open) reuse in the context of design communities. For example, this type of visualization may help in the process of collecting relevant data such as participants' interaction during a co-design process. The managing of these replicas and their presentation to designers should be handled carefully in order to be accessible. There are two main problems associated to handling the replicas: in the one hand, the potentially high amount of replicas that can be created for a given design or its replicas and, on the other hand, the problem of modelling the relationships between the replicas so that they are comprehensible and profitable for practitioners.

In particular, we propose an LdS branching model that is visualized following a family-tree metaphor. We define as a "parent" LdS the initial material created by practitioners from scratch or from initial design patterns or templates that can be duplicated in order to develop future LdS. And, we define as progeny or child, as any duplication or replica of a parent LdS. Designers accessing to a learning design can navigate through its design family tree visualization of linked replicas (original design, refinements, etc.), which may be created by the same designer or diverse teachers. The visualization should graduate the quantity of refinements and sub-refinements presented, while enabling navigation through all the LdS generated. The family tree metaphor enables users to easily identify and see the direct refinements of a particular LdS (parents and progeny), but also see other refinements from Ld with common ancestors. In this sense, we open the designers' perspective allowing them to take in account, if wanted, the multiple possibilities already considered, and shared, by other teachers.

The family-tree metaphor is also used to model and computationally represent the replicas in the software implementing the metaphor. The implementation is being carried as part of the "Integrated Learning Design Environment" (ILDE) (Hernández-Leo, Chacón, Prieto et al., 2013), which is being development in the context of the Metis European project. In particular, the implementation is extending the LdShake Web platform (Hernández-Leo et al., 2011), which is the element of the ILDE supporting the teacher social network, acting as the designs' repository and managing the access and floor control to design and implementation tools. The definition and implementation of the designs (i.e. their bindings with specific Virtual Learning Environments – VLEs- and students) are generally called in LdShake/ILDE as LdS (Learning design Solutions).

The remainder of the paper is organized as follows. Next section defines the family tree metaphor, the model behind and the interaction design sketched for its implementation. Then, we describe the implementation of the proposed feature in the ILDE. Preliminary evaluation results are discussed in the following section. The evaluation is based on a survey, in which learning design experts have valued the relevance and utility of the feature to support learning design situations as well as the usability of its implementation. The results are discussed in Section 4. Finally, section 5 describes the main conclusions of the paper and the future work.

The learning design "family tree" metaphor

The ILDE provides a social network for learning design communities where their members can collaborate in the co-creation of learning designs using several authoring tools (Hernández-Leo, Chacón, Prieto, et al., 2013). In particular, the ILDE integrates a set of learning design text-based templates proposed by the OULDI project (Cross, Galley, Brasher & Weller, 2012), a rich text editor for other conceptualizations and several specific authoring tools that enable the creation of ready-to-run designs (in VLEs), such as WebCollage (Villasclaras-

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Fernández, Hernández-Leo, Asensió-Perez et al., 2013), OpenGLM (Derntl, Neuman & Oberhuemer, 2011) or CADMOS (Katsamani & Retalis, 2011).
In the ILDE when a user creates a new design, he or she became the starter of that LdS. Although the platform allows creating and sharing new designs, only the creator (or LdS starter) can decide over some of LdS rights, as who can edit or who can view such design. The platform also offers other useful collaboration features, such as the possibility of creating working groups and the inclusion of a repository where all the LdS are stored. In order to help user's navigation, the platform allows categorizing LdS. This categorization is supported through the addition of tags to LdS (Hernández-Leo, Moreno, Chacón & Blat, accepted).

In our previous research (Hernández-Leo, Moreno, Chacón & Blat, accepted; Hernández-Leo et al., 2011), we saw that sometimes teachers hesitate when they have to modify the work done by the starter or original designer, even if they have editing rights. Unsurprisingly, this finding depends on the type of learning design situation that contextualizes the position of the teacher. Table 1 summarizes a set of cases representing learning design situations where the aforementioned problem appears and additional situations that may benefit from the support for the management of learning design replicas or duplications. By enabling LdS duplication, we allow users to respect an original work. Moreover, if a teacher wants to re-use an LdS, they can duplicate, refine and adapt the LdS according to their needs and contexts. Furthermore, when a teacher duplicates an LdS, s/he gains full "ownership" of the design, as s/he is now the starter of the new LdS (reusing the design being duplicated). However, the management of the designs should still recognize the authors of the original design.

Table 1 Learning design situations addressed with the family-tree metaphor

	Learning design situations
Case 1	Teachers reuse a design the following academic years with minor adaptations. It would be interesting for the teachers to keep track of the "design's life" across time.
Case 2	New teachers reuse previously existing designs for their new subjects with their particular adaptations. It would be interesting to keep track of the designs across time.
Case 3	A design is co-outlined by teacher teams and later refined by each teacher for their particular group of students. It would be nice to keep track of the original design and the multiple variations.
Case 4	When teacher views a design of her/his interest (for potential reuse), she/he would like to know if there are variations of the same (similar) design
Case 5	Some teachers don't feel comfortable modifying an existing design (even if they have been invited as co-editors) and prefer working on a "duplication" of the design.

There are additional aspects that motivate the relevance of this set of learning design situations presented in Table 1. The creation and design of LdS is no trivial. There are evidences in the literature that show the challenges around teachers designing from scratch (Griffiths & Blat, 2005). A solution to face this problem is to support the design process through the reuse of existing material to create new one (Hernández-Leo, Harrer, et al., 2007). In this context, all the cases presented in Table 1 entail reuse of existing designs. A feature supporting the duplication of designs back this type of reuse requirements but also situations of teachers reusing their own previous designs across time, and scenarios of teams of teachers applying the same design with multiple groups of students. Multiple duplications of an LdS may lead to scenarios with relatively high amounts of LdS replicas. We need a feature, within LdShake/ILDE to manage this amount of LdS replicas and their relations and a user friendly approach to visualize and facilitate navigation through LdS.

To approach the design of the feature, we considered the use of a metaphor that would facilitate designers an overview of the existing replicas of a design and its relations. The use of metaphors is common in human computer interaction design (Helander, Landauer & Praby, 1997). Lakoff and Johnson (1980) describe the use of metaphors as a way of "understanding and experiencing one kind of thing in terms of another". They claim that metaphors are not only pervasive in language, but that they are a fundamental part of our conceptual system of thought and action. Metaphors have been proved to help users understand the use of computers, applications, etc. (Imaz, M., & Benyon, D., 2007). In particular, we have identified the Family Tree metaphor as an interesting metaphor to represent, manage and relate the different LdS within the ILDE. In this sense, we deal with a collection of Ld Sinterrelated as if it was a «learning design family». We define a «learning design family» as a collection of learning designs which were not started from scratch but by replicating (or

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duplicating) a particular existing designs (exemplar or template). A “parent” LdS is the initial material created by practitioners from scratch. A progeny or child is as any duplication or replica of a parent LdS.
The visual design of the family tree metaphor includes a box with LdS basic information as title, tags or the picture of the LdS Starter, see Figure 1 B. In order to see the ancestor we added an option to display or collapse it, see Figure 1 A and G. Clicking Figure 1 A we will display the ancestors or offspring. While if we click Figure 1 G we will collapse the ancestors or children. We represent relationships between LdS using arrow where the arrowhead while point the offspring, see Fig 1 F. We also added some options in order to show LdS siblings, other duplications from the same ancestor, see Figure 1 C. Furthermore we have the option to show cousins, see Figure 1 D. In the design we also include an icon that lead to a small visualization of the LdS overview.

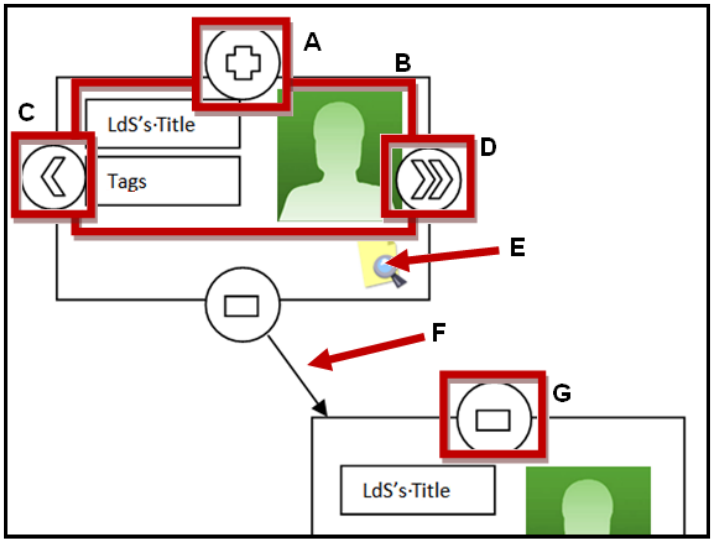

Figure 1: LdS visualization design using the family tree metaphor

Learning designs branching tool

Besides the learning-design family tree visualization, we have also implemented a module to manage, store and retrieve the information related to the replicas. Both the visualization and the management module have been implemented in the ILDE. In particular, the module has been integrated in the LdShake platform and is accessible within the LdS visualization section. In this way, when a user is viewing a particular LdS, but only if the user has editing rights, the user will see the «Duplicate this LdS», see Figure 2 A, and the «View duplicates» options, see Figure 2 B. On the one hand, clicking on «Duplicate this LdS» the system makes a replica of the actual LdS and asks for a new name. Internally speaking, the module also stores a relation between the original LdS and the duplicate, tagging the replica as offspring or progeny of the original LdS. On the other hand, clicking on the «View duplicates» option, triggers the load of a new screen where the family tree visualization of the actual LdS is displayed, see Figure 3. The data used to generate the family tree is extracted from the ILDE platform and the replicas that are generated within the design community.

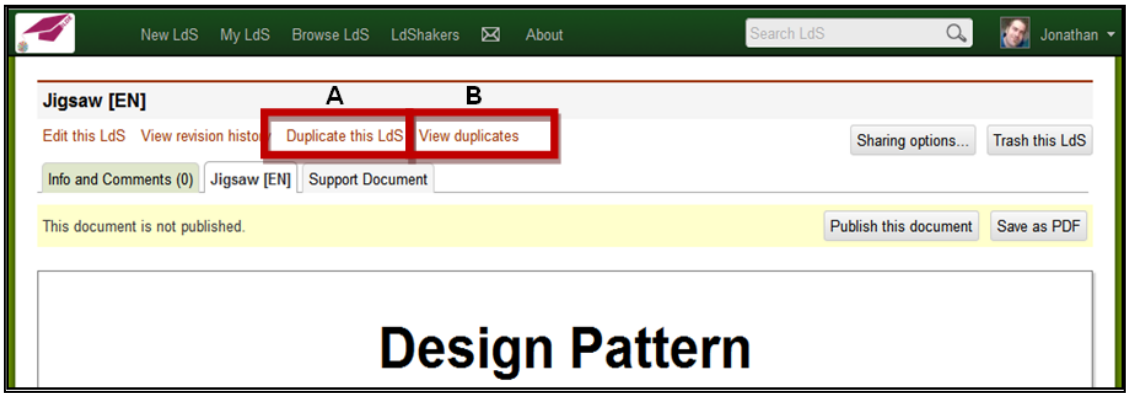

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Figure 2: LdS description view showing where we included our plug-in options

We have planned the implementation in two iterative cycles, and are currently in the final phase of the first cycle. The first cycle covers a first implementation of the metaphor as a plug-in for the ILDE and the basics options (see Figure 3 for a general view of how it is visualized within the ILDE platform). Using this implementation, we have collected early feedback from learning design experts and will also gather data from users to evaluate the utility of the proposed metaphor, its implementation, and to identify lines for improvement in the second phase. During the second phase, we will refine the first implementation according to the feedback of the first phase and extend the tool with the advanced functionalities described in the previous section. The resulting implementation in the second cycle will be evaluated again with teachers in several educational contexts.

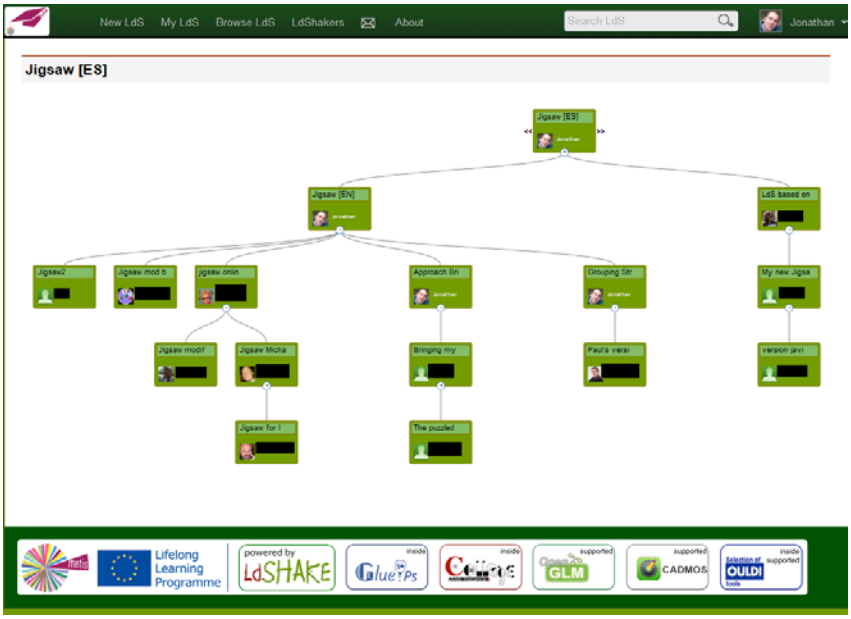

Figure 3: Family Tree Visualization Screen

The first cycle implementation uses a green box to represent a particular LdS, see Figure 4 A. Any descendent relation or antecedent relation is marked with a circle. If the circle contains a «-» inside, it means that children LdS are displayed, see Figure 4 B. If we click on the circle, the «-» will convert in a «+», which means that this LdS has one or more replicas that are not displayed, see Figure 4 C. Furthermore, every green box has 2 parts: the name of the LdS (Figure 4 D) and the picture and name of the LdS replica's starter (Figure 4 F). To situate the given LdS from which its family tree is consulted, the LdS is visualized highlighted with "«" and "»" marks, see Figure 4 E. Finally, the relationships between LdS is denoted by black lines, see Figure 4 G.

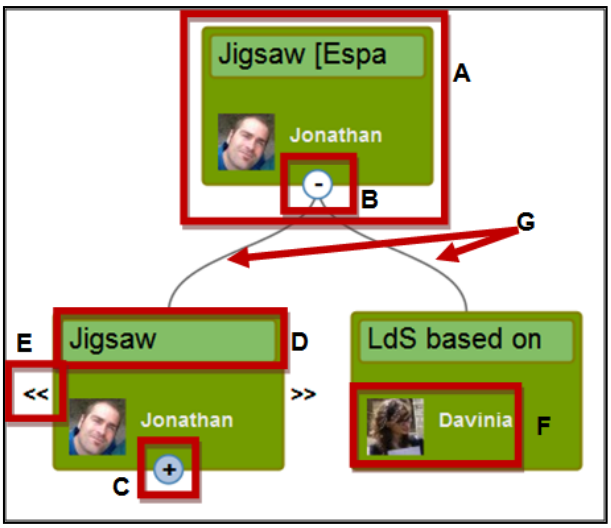

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Figure 4: Visualization elements description

Preliminary evaluation

We invited 13 learning design experts to try the new ILDE feature implementing the family-tree metaphor. Most of them are members of the Metis project, but none of them was involved in the design of the metaphor and its implementation. However, they were familiar with the ILDE system. 11 of them accepted the invitation (3 female and 8 male experts). The 11 experts have more than 5 years of experience in the area of learning technologies and learning design. The evaluation was carried out asynchronously, from the distance. We sent to experts the instructions on how to use the new ILDE feature using an e-mail message. The message included an introduction about the "learning designs' families" concept and the "Family Tree" metaphor. Then, the instructions suggested them to complete a set of short tasks with the ILDE that had to do with the use of the new feature. Summarizing, we ask them to navigate the family tree visualization, to select an LdS and then to try to duplicate and refine it. Part of the resulting tree generated as the outcome of this activity is displayed in Figure 3. Finally, we asked them to fill in an online questionnaire in which the experts have valued the relevance and utility of the feature to support the learning design situations (or cases) described in Table 1 as well as the usability of its implementation. The questionnaire included several Lickert scale questions and two open questions inviting experts to discuss the cases and the utility / usability of the proposed metaphor and implementation.

Table 2 shows the results obtained for the first two Lickert scale questions. The first question inquired about the experts' opinions around the relevance of the cases listed in Table 1. We wanted to understand if they also see the cases as important situations that learning design research should address. They could rate each case in a scale from 1 "not relevant at all" to 5 "relevant" (the "not applicable" option (NA) was also offered). On the one hand, the experts value all of the cases as quite relevant (average rating from 3.8 to 4.5). They highlight cases 1, 3 and 5 as the most relevant cases (with a mean score of 4.5 out of 5, see Table 2), followed closely by case 2 (average rating of 4.4). These cases reflect practical situations of reuse across time and across teachers of a particular design and a situation of collaboration among teachers on a particular design. The lowest relevance rating given to the case considering a situation in which a teacher willing to reuse a design may be interested in looking at variations of that design. Even though the relevance of this case is less prominent than in the other cases, its relevance rating is still positive (3.8) and supported by additional qualitative comments by the experts, "A teacher might wish to see examples of use of a design/pattern to better understand how it works."

The experts are also positive about the usefulness of the implemented feature to support those learning design situations They rated the usefulness of feature for each case using a scale ranging from 1 "not useful at all" to 5 "very useful". The usefulness of the feature is especially clear to them in cases 1, 2, 5 with an average rating of 4.6, 4.7 and 4.6 respectively. These quantitative ratings are also backed up with open comments, such as "It is a very useful addition to the ILDE,", "It'll be very useful for those courses that involve many teachers and that require adaptations of the materials from one year to another. I'm a teacher of a Programming course that involves 10 teachers and around 250 students. Since the subject changes every year it is necessary to adapt some of the existing content. With this feature it would be possible to have an overview of the adaptation of these contents year after year at the same time that teachers could collaborate in the advance of these materials", and "I was using previous designs of my own course or I was adapting myself to the design created by the leading colleague of a course. In any case, reuse of previous designs is a common feature of my own practice (and probably of other practitioners, as far as I know)." The usefulness of the feature to tackle case 4 is less clear. It seems that usability issues related to the information displayed for each design hinders an easy understand about variations across family-related designs.

Table 2 Sampling scores of teachers on issues regarding Relevance and Usefulness (Scale de 1 – 5; where 1 means "no relevant at all" and 5 means "relevant")

Learning design situation	Relevance		Usefulness	
	Distribution of scores Score (# experts)	Mean score	Distribution of scores Score (#experts)	Mean score
Case 1	3(1)-4(4)-5(6)	4.5	4(4)-5(6)- NA (1)	4.6
Case 2	2(1)-4(4)-5(6)	4.4	4(3)-5(7)- NA (1)	4.7
Case 3	4(6)-5(5)	4.5	4(7)-5(3)- NA (1)	4.3
Case 4	2(1)-3(2)-4(6)-5(2)	3.8	1(1)-2(1)-3(1)-4(3)-5(4)- NA (1)	3.8

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Case 5	3(1)-4(3)-5(7)	4.5	4(4)-5(6)-NA(1)	4.6

Table 3 shows the experts' ratings around usability issues. Given a set of statements on the design-implementation of the metaphor, we asked them to indicate their degree of agreement with each of them. The scale ranged from 1 "fully disagree" to 5 "totally agree" (and included the "not applicable" option). In the table we can see that the "e" aspect was the highly rated with a mean score of 4.8 out of 5. The implemented visualization following a branching model offers users a feeling of a learning design family tree. In general, the visualization is clear (d) and provides multiple visions of similar designs (c). However, there are different opinions regarding the comprehensiveness of the information provided in the visualization (b) ad provided several suggestions on how to improve that aspect and the display of the design of which the user consulted the family tree (a).

Table 3 Sampling scores of teachers on issues regarding Usability (Scale de 1 – 5; where 1 means "fully disagree" and 5 means "totally agree")

		Distribution of scores Score (#experts)	Mean score
a	I could see where the design I was viewing was situated in the tree	2(2)-3(2)-4(4)-5(3)	3.7
b	The name, picture of the main author and their name are enough information	1(1)-2(2)-3(2)-4(4)-5(2)	3.4
c	The possibility of different generations allow me to see multiple visions of the same work	3(1)-4(3)-5(6)-NA(1)	4.5
d	Elements within the display are clear and easy to understand	2(1)-3(2)-4(4)-5(4)	4.0
e	The elements distribution give me the feeling of a Family Tree visualization	4(2)-5(9)	4.8

Conclusion and future work

To support a set of learning design situations that involve collaboration among teachers and/or reuse of learning designs, this paper has proposed the concept of "learning designs' family" and the use of a branching model to implement the concept. The implementation manages and visualizes multiple replicas of a design following a familiyttree metaphor. Both the family tree metaphor and the LdS branching model solve problems related to replication of designs, such as: managing high amounts of LdS and presenting the relationships of LdS in a comprehensible and profitable way to the teachers. The implementation is included in the Integrated Learning Design Environment being developed in the Metis project. With this new feature users can duplicate any LdS and track duplications of designs.

We invited a group of learning design experts to complete a preliminary evaluation of the feature and get the first feedback of our approach. The results of this preliminary evaluation are encouraging. The experts recognize the importance of the learning (co-)design situations addressed and rate this addition to the ILDE as an useful feature to support those situations. The usability of the feature, and the metaphor behind, is also valued positively. The experts also pointed out several suggestions to refine the implementation (e.g., including 'mouse-over' tooltip with additional information of the designs; adding zoom in and zoom out options, etc.). The second iteration in the modelling and implementation of the feature will include those suggestions and will extend the feature with advanced functionalities related to extended visualizations (i.e., also including cousins, etc.), offering previews of the LdS in the family tree, etc. The current implementation and its extension will be used in longitudinal workshops with teachers in the context of the Metis project.

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