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# A Review, Timeline, and Categorization of Learning Design Tools

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**Abstract.** Enabling teachers to define or portray efficient teaching ideas for sharing, reuse or adaptation has attracted the interest of Learning Design researchers and has led to the development of a variety of learning design tools. In this paper, we introduce a multi-dimensional framework for the analysis of learning design tools and use it to review twenty-nine tools currently available to researchers and practitioners. Lastly, we categorise these tools according to the main functionality that they offer.

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**Keywords:** Learning Design · Learning design tools · Learning design practice · Learning analytics

## 1 Introduction

Learning Design (LD) is a research field that is concerned with the educational processes of planning, sequencing and managing learning activities, supporting teachers in delivering and sharing teaching ideas to improve learning of students [1]. In LD, the emphasis is on the pedagogical intent, following high-level design principles positioned in the framework of socio-cultural educational research. In practice this has led researchers to develop various representations to define and document learning design ideas [2], such as the Educational Modelling Language, the IMS Learning Design, Learning Activity Management Systems (LAMS), digital representations, and patterns.

Moreover, our literature search identified twenty-nine digital learning design tools: the Integrated Learning Design Environment (ILDE) [1], The Learning Designer [3], CADMOS [4], Reload [5], LD Tool [2], HKU Learning Design Studio [6], LAMS [7], GLUE!PS [8], LdShake [9], ScenEdit [10], CeLS [11], DialogPLUS [12], WebCollage [13], MOT+ [14], exeLearning [15], coppercore [15], GLOMaker [16], Pedagogic Pattern Collector [17], ReCourse [5], CompendiumLD [18], Pedagogical Plan Manager [19], PHOEBE [20], OpenGLM [21], LAMS Activity Planner [22], OpenScenario [23], HEART [24], Cloudworks [25], Map My Programme [26], and LAMS v2 [7].

Even though there have been many attempts to model learning design and develop tools for practitioners, the issue of representation of the learning design remains one of the central concerns of the field [27]. According to Mor et al. [28], representing teaching practice in meaningful ways for teachers to understand, discuss, share ideas remains problematic and requires further investigation. Another relevant concern is the lack of an agreed common language used among the tools developed so far [28].

Although this is understandable due to the complexity of the LD process, creating a common language is an area that needs to be further explored. Additionally, in spite of the richness of the representation tools, practitioners' adoption of these tools falls behind expectations.

The aim of this paper is to provide an updated view of the area of LD tools to facilitate further work. To this end, we review available LD tools using a new evaluation framework, create a timeline of LD tools, and organise LD tools according to their functionality. The rest of the paper is organised as follows. Section 2 introduces a multi-dimensional framework while Sect. 3 presents an analysis of the tools. Finally, Sect. 4 provides conclusions and considers future prospects for LD tools.

## 2 A Multi-dimensional Framework

In the field of LD, there have been studies about specific LD tools illustrating their functionalities and innovative characteristics, compared to the relevant state-of-the-art. There has been a small number of attempts to review the literature, however, as Britain points out, there is a wide range of LD tools, so it is difficult to present a comprehensive evaluation of them [15]. Later in [29] Britain proposed an evaluation framework and reviewed a limited number of LD tools. In another study, Conole [30] reviewed seven learning design tools, whilst later Dalziel et al. [26] presented a wide range of LD tools but was not able to cover all of them.

In terms of organising tools in different categories, Britain [29] categorised tools as authoring environments, run-time environments, and integrated environments. Conole [30] distinguished LD tools into visualisation tools, pedagogical planners, generic tools, and learning design resources. With respect to the learning design representation used in the tools, within the same study, Conole [30] organised the tools in two groups: textual representation and visual representation. More recently, Persico and Pozzi [31] categorised LD tools based on their functionality into reflection tools and pedagogical planners, authoring and sharing tools, repositories, and delivery tools.

In this paper, we adopt an approach that is based on a reconceptualization of the framework proposed by Britain [29]. One of the distinct differences of our framework from Britain's is that our framework evaluates the tools in terms of their facilities that consider learning analytics. Another dimensions introduced compared to Britain's approach is that our framework considers the tools with regards to their ability to deploy learning designs into VLEs, export and import learning designs into different file formats. Like Britain's framework, our framework also consists of three main sections: general properties, learning design properties, and technical properties. The main sections and their subsections associated with their corresponding meanings are presented in Table 1. The general properties section comprises of five subsections, the learning design properties section have four subsections, and there are three subsections in technical properties section.

**Table 1.** Evaluation framework used in the study

General properties	Scope	What is the main function of the tool?
	Release date	What is the release date of the tool. Does the tool still exist?
	Target users	Who is the system for?
	Export & Import	Can the tool import and export of LDs into other file formats?
	VLEs	Can the tool deploy LDs into Virtual Learning Environments?
Learning design	Design language	What notation language does the tool use?
	Activity model	How the tool illustrate activities?
	Workflow model pl	What is the model used in the representation of the LD flow?
	Learning analytics	Does the tool have any functionality regarding learning analytics?
Technical	Form of software	What is the form of the software of the tool?
	User interface	What does the tool present in terms of user interface?
	Technical needs	Does the tool have any technical requirement or additional software to run the application?

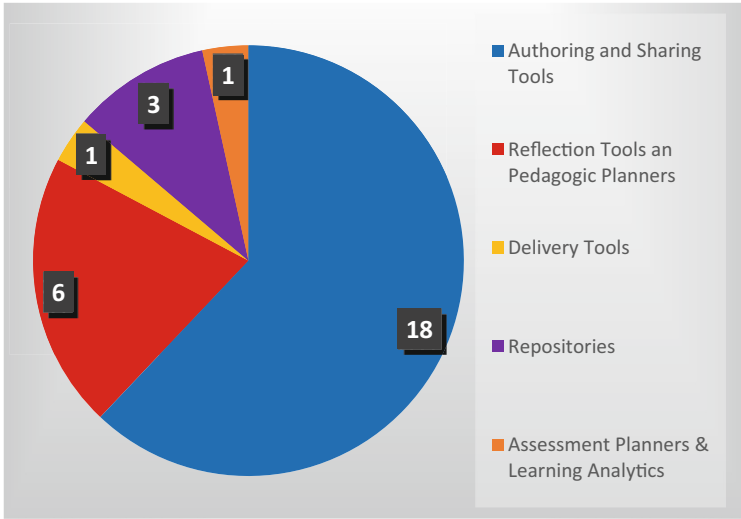
### 3 An Analysis of the Tools

Our analysis adopts the key categories suggested in [31], namely authoring and sharing tools, reflection tools and pedagogical planners, repositories, and delivery tools, with the addition of assessment planners and learning analytics. The analysis covers 29 tools- the number of the tools in each category is graphically presented in Fig. 1.

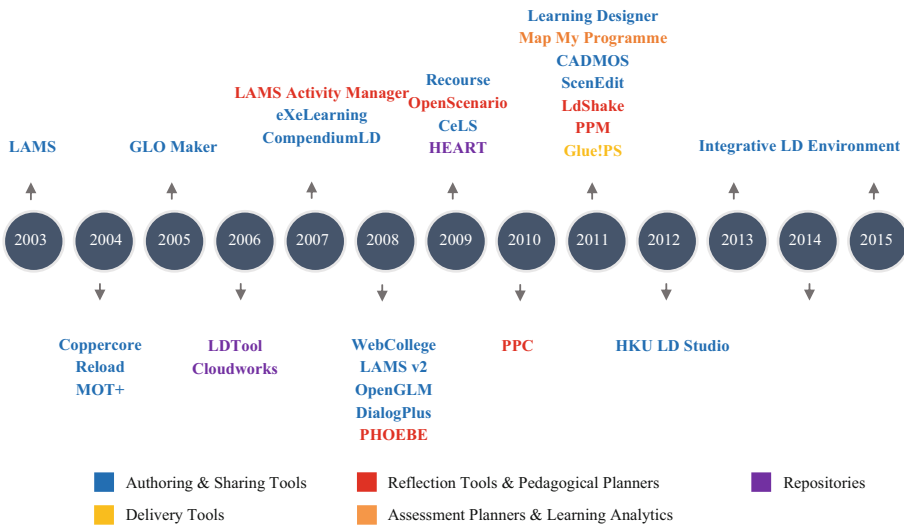
A timeline of the learning design tools is presented in Fig. 2. In this timeline, we present approximate dates that the 29 tools were released, and use colours to indicate the category that each belongs. Authoring and sharing tools include LAMS, Coppercore, Reload, MOT+ , GLOMaker, exeLearning, CompendiumLD, WebCollege, LAMS v2, OpenGLM, DialogPlus, Recourse, CeLS, Learning Designer, CADMOS, ScenEdit, HKU Learning Design Studio, and ILDE. LAMS Activity Manager, PHOEBE, OpenScenario, PPM, LdShake, and PPC go into the category of reflection tools and pedagogical planners. Repositories include HEART, LDTTool, and Cloudworks. There is only GLUE!PS tool in the category of delivery tools. Lastly, the category of assessment planners & learning analytics includes Map My Programme.

#### 3.1 Authoring and Sharing Tools

According to Persico and Pozzi [31], the group of authoring and sharing tools includes tools which “allow the representation of activities and are rooted in specific



**Fig. 1.** The distribution of the tools according to the categorisation



**Fig. 2.** The timeline and categorisation of learning design tools

pedagogical models”. As presented in the timeline, eighteen authoring and sharing tools are placed in this category. We present their characteristics in line with the dimensions of the evaluation framework in Tables 2 and 3-only tools that are still functioning are included.

**Table 2.** An analysis of authoring and sharing tools.

	ILDE	HKU LD Studio	Learning Designer	GLO Maker	CeLS	Web Collage	Dialog PLUS	MOT+	
<b>GENERAL PROPERTIES</b>	<b>Scope</b>	Authoring, sharing, editing, exploring	Authoring (For self-directed activities)	Authoring (create, share, edit and reuse)	Authoring	Create and reuse activity	Authoring tool (pattern-based)	Authoring tool	Authoring tool
	<b>Release date</b>	2012– still running	2013 – still running	2011 – still running	2006 – Not available	2009 – still running	2006 – still running	2006 – Not available	2008 – Not available
	<b>Target users</b>	Teachers	Teachers	Teachers,	Teacher-designers	Teachers and researchers	K-12 teachers	Teachers	Teachers
	<b>Export &amp; Import</b>		JSON file.	MS Word, shared as an URL	N/A	XML-based model	IMS LD (A level)	IMS LD	IMS LD
	<b>Deploy into VLEs</b>	Moodle, SCORM, metisVLE, MediaWiki	N/A	N/A	N/A	N/A	LAMS, Moodle	N/A	LAMS, Moodle
<b>LEARNING DESIGN</b>	<b>Design language</b>	Integration of LD tools	Text-based (Similar to IMS-LD)	Formal learning concepts	Text-based	N/A	Graphical and pattern based	Nugget taxonomy language	Graphic-based, formal
	<b>Activity model</b>	OpenGLM, WebCollege, exeLearning, CADMOS	It follows the sequence of learning.	In sequence, similar to lesson plan	Sequential	Presentation, input, interaction, dialog	Collaborative activity patterns	Nugget Model	IMS LD
	<b>Workflow model</b>	OpenGLM, WebCollege, exeLearning, CADMOS	It follows the sequence of learning.	Main properties of a learning design	Sequential	XML-based model	Collaborative learning flow patterns	Nugget Model	IMS LD
	<b>Learning analytics</b>	Peer-review evaluation of LDs	N/A	Graphical show of activities	N/A	N/A	Provides assessment patterns.	N/A	N/A
<b>TECHNICAL</b>	<b>Form of software</b>	Web-based	Web-based	Web and desktop based, Mobile App	Web-based	Web-based	Desktop-based, web-based	Web-based	Web-based
	<b>User interface</b>	Easy-to-use	Comprised of two steps.	Interactive	N/A	Interrelated stages	Flexible	N/A	N/A
	<b>Technical needs</b>	Java Run-Time	N/A	Windows, Mac, Linux	N/A	Internet Explorer 5	N/A	N/A	N/A

### 3.2 Assessment Planners and Learning Analytics

Tools that mainly focus on informing learning in terms of learning analytics are listed in this category, as shown in Table 4.

**Table 3.** An analysis of authoring and sharing tools.

	LAMS	eXe Learning	Copper Core	CADMOS	Recourse	Open GLM	Compendium LD	Reload	
<b>GENERAL PROPERTIES</b>	<b>Scope</b>	Authoring, Community, and Run-time Environment	Authoring tool	Authoring tool	Authoring tool	Authoring tool (IMS LD compliant)	Authoring tool (create, share and reuse)	Authoring and runtime learning environment	
	<b>Release date</b>	2003 – still running	2007 – still running	2004 – still running	2011 – still running	2009 – still running	2006 – still running	2005/06 – still running – 2004/2005 still running	
	<b>Target users</b>	Teachers	Teachers, academics	Teachers	Novice teachers	Teachers (IMS LD)	Non-professional user	Lecturers, teachers	Teachers (familiar to IMS LD)
	<b>Export &amp; Import</b>	LAMS, IMS LD	IMS LD, HTML5, ePub3	IMS LD (A, B, C Levels)	IMS LD (A, B), MS Word	IMS LD	IMS LD (A, B), ILDE	IMS LD	IMS LD (A, B, C), XML format
	<b>Deploy into VLEs</b>	Moodle, Blackboard, Sakai, LRSN, WebCT, SharePoint, OLAT, Desire2Learn	SCORM, Moodle	N/A	Moodle.	LAMS, Moodle	Moodle	LAMS, Moodle	N/A
<b>LEARNING DESIGN</b>	<b>Design language</b>	Visual-based descriptive language	IMS LD, SCORM	IMS LD	Visual-based in layers	Graphical and pattern based	Graphical and pattern based	Visual-based	Contains all entities of IMS LD
	<b>Activity model</b>	LAMS educational workflow system	IMS LD, SCORM	IMS LD	Conceptual/flow model	IMS LD	Visual modelling metaphor	Mind mapping, or concept mapping	IMS LD
	<b>Workflow model</b>	LAMS educational workflow system	IMS LD, SCORM	IMS LD	Conceptual/flow model	IMS LD	Visual modelling metaphor	Mind mapping, or concept mapping	IMS LD
	<b>Learning analytics</b>	Monitors progress of a student	N/A	N/A	N/A	N/A	N/A	Allows users to think on assessments	N/A
<b>TECHNICAL</b>	<b>Form of software</b>	Desktop-based	Desktop-based	Desktop-based	Desktop-based	Desktop-based	Web-based	Web-based	Desktop-based
	<b>User interface</b>	Drag and drop user interface	N/A	N/A	User-friendly	Visual based	Comprised of panes	Flexible, simple	Tabs and editing fields
	<b>Technical needs</b>	Written in Java and operated in cross platforms	N/A	N/A	N/A	Java Run-Time	Java Run-Time	N/A	Java Run-Time

### 3.3 Reflection Tools and Pedagogical Planners

Tools in this category are intended to “help the teacher/designer reflect on the pedagogical choices to take, thus supporting the process of decision-making” [31]. These are shown in Table 5.

**Table 4.** An analysis of assessment planners and learning analytics

		Map My Programme
General properties	Scope	Mapping and planning assessments
	Release date	2011 – still running
	Target users	Teachers
	Export & Import	N/A
	Deploy into VLEs	N/A
Learning design	Design language	Visual-based
	Activity model	N/A
	Workflow model	N/A
	Learning analytics	The tool provides summative and formative evaluation of the assessments.
Technical	Form of software	Web-based
	User interface	N/A
	Technical needs	Google Account

**Table 5.** An analysis of reflection tools and pedagogical planners

		PPC	PHOEBE	LdShake	OpenScenario	Lams AP	PPM
GENERAL PROPERTIES	Scope	Pedagogical Pattern Collector	Pedagogic planner	Social network oriented tool	Scenario-based tool	Create learning activities	Pedagogic planning of LDs
	Release date	2011 – still running	2006 – Not available	2011 – still running	2009 – Not available	2007 – still running	2010 – still running
	Target users	Teachers	Teachers	Teachers	Teachers	Teachers	Teachers
	Export & Import	N/A	N/A	N/A	N/A	N/A	N/A
	Deploy into VLEs	N/A	N/A	N/A	N/A	Moodle	N/A
LEARNING DESIGN	Design language	Pattern-based	Wiki-based, and set of resource	Various pedagogical approaches	Scenario-based design	Sequential	Hierarchical entities
	Activity model	Cognitive model	Sequence structures	4SPPIces Model	Scenario-based model	Sequential	Pedagogical Hierarchy
	Workflow model	Cognitive model	Sequence structures	4SPPIces Model	Organization, learning, observation, evaluation	Sequential	Pedagogical Hierarchy
	Learning analytics	N/A	Assessment and activities	N/A	N/A	N/A	N/A
TECHNICAL	Form of software	Web-based	Web-based	Web and desktop based	Web-based	Web-based	Web-based
	User interface	Browser, designer, abstractor	N/A	N/A	Flexible	N/A	Hierarchy Manager, Field Sector, Data Area
	Technical needs	N/A	N/A	N/A	N/A	Flash Player	N/A



### 3.4 Delivery Tools

Delivery tools are specifically designed to support the delivery of the activities and learning design into learning environment. A tool in this category is evaluated in Table 6.

**Table 6.** An analysis of delivery tools

		GLUE!PS
General properties	Scope	It allows integration of existing external tools including Google Docs, Google Spreadsheets, Google Presentations, Dabbleboard, Noteflight, Doodle, Wookie Widgets.
	Release date	2011 – still running
	Target users	Teachers, practitioners, researchers
	Export & Import	Supports IMS LD specification (Level A equivalent)
	Deploy into VLEs	Moodle, MediaWiki, LAMS
Learning design	Design language	N/A
	Activity model	N/A
	Workflow model	N/A
	Learning analytics	N/A
Technical	Form of software	Middleware architecture, Desktop-based
	User interface	N/A
	Technical needs	N/A

### 3.5 Repositories

This category defines the tools that provide teachers learning design ideas, sample of practices, and experiences' reports. Tools analysed across the dimensions identified in the framework are presented in Table 7.

**Table 7.** An analysis of repositories

	<b>Cloudworks</b>	<b>HEART</b>	<b>LDTTool</b>	
<b>GENERAL PROPERTIES</b>	<b>Scope</b>	Social networking environment	Learning design support strategy	Authoring, sharing, and browsing among existing LDs
	<b>Release date</b>	2008 – still running	2009 – Not available anymore	2008 – still running
	<b>Target users</b>	Teachers	Teachers	Teachers (Primary, secondary, and higher education teachers)
	<b>Export &amp; Import</b>	N/A	N/A	N/A
	<b>Deploy into VLEs</b>	N/A	N/A	N/A
<b>LEARNING DESIGN</b>	<b>Design language</b>	N/A	Visual and text based	Text-based
	<b>Activity model</b>	N/A	Pedagogical dimension	Sequence of learning tasks
	<b>Workflow model</b>	N/A	Pedagogical dimension	Description, intended learning outcomes, resources, tasks, supports
	<b>Learning analytics</b>	Peer feedback	N/A	N/A
<b>TECHNICAL</b>	<b>Form of software</b>	Web-based	Web-based	Web-based
	<b>User interface</b>	N/A	Graphical and text based presentation of the contents	Description, intended learning outcomes, resources, tasks, and supports sections are presented to be filled by a user
	<b>Technical needs</b>	N/A	N/A	N/A

## 4 Conclusion and Future Works

The purpose of this paper was to present all LD tools in one place and analyse them along the same dimensions. In the paper, we distinguished the tools based on their functionality, and provided a timeline for LD tools. Twenty-nine learning design tools from the literature of the LD field were identified as still functioning. These were categorised according to their functionality, and a timeline of these tools associated with their categorisation was created.

It is worth to highlight that ILDE is the most recent tool developed within the field. According to Maina et al. [27], “a promising step in this direction is the ILDE” as it focuses on integration of the various tools available rather than creating a new one.

The findings of this paper have a number of implications for future practice. First, further research could be conducted to compare teachers’ learning design practices of using these tools on the same topic. Second, an analysis of the pedagogical underpinning behind these tools would be also useful. Finally, usability and user interface characteristics of the LD tools would worth further investigation.

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