XLearning Object Organization Behaviors in a Home-Made Learning Content Management System

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ABSTRACT

This study designed, implemented and evaluated a learning content management system to facilitate creating both standard based and free style learning objects. The system, BULeCoMas, also enabled users to tag learning objects with usage data and tools supported with components accommodated under a Global Activity Center, are Global Task Pool, Experience Repository and Learner Record Repository. This study examined whether the experience in information technology use affect e-learning object authors';

- **use of assets,**
- **organization of assets and**
- **embedding of instructional elements into their content authoring.**

The system, enabling common standards of reusable learning objects, was tested for ease of use with thirty-four novice and experienced preservice teachers. The participants found the system easy to use in general, novice and experienced information technology users were able to develop learning objects similar in size and features. The study suggests some further work for using the same system in collaborative learning object authoring.

Keywords: **Elements of learning object; learning object, content management system.**

CONTENT AND LEARNING OBJECT AUTHORING

In organizations of today, everyone needs speedy access to information and knowledge. Information exchange between triangle of business, employees and consumers provide the core of knowledge, experience and expertise which support both organizations and their users and customers.

To collect all information in an organization continuously requires great effort as they will be provided by different individuals/departments in different formats including text, graphics supported with text, images, videos and audio and may be animation. The format of each chunk of information may comply with a different set of digital applications.

A department might provide its textual information in MS Word format, another provides it in Adobe pdf format, an information author submits his training materials in a slide presentation and another submits in an authoring system file. Once information is collected, it is to be made accessible, understandable, linked to relevant body of information resources and perhaps reorganized.

The collected information is also to be updated, corrected, approved and archived. In this cycle, it is obvious that information content is an asset that must be managed (Haggie & Kingston, 2003). Hackos & Joann (2002) propose that if the content developed in a modular and structured form, updating chunks of content without having to recreate the entire collection will be easy; chunking, structuring and labeling turn content into a valuable commodity.

To ensure integrity, volume, creation, dissemination and storage of content, organizations need the support of technology to keep the system active. The technology that supports information creation, storage and dissemination is defined as content management system (CMS). A CMS in an organization may be used for product development, marketing, sales support, order management, customer relations, supply chain, information development, technical support and publication and training.

Four primary components of a CMS are authoring, linking and publishing, assembly and repository (Hackos & Joann, 2002). In a typical CMS, information is either authored by the organization or brought in from outside the organization, but it is the content and once linked and placed into the CMS, it is ready for viewing and studying by the target users. The content in a CMS is kept in the form of information objects stored in CMS repository. Information objects can be searched and retrieved by authors and others in need of information.

All the interactions of users with the information objects may be monitored and controlled by the CMS. The concern of learnability of the content is, however, not a question and the most effort put on the setup and production of the content.

Data and information are not enough to make decisions based upon organized and filtered knowledge. As the amount of knowledge increases, as the characteristics of knowledge change and knowledge based decision becomes more and more critical, rapidly accessing knowledge is vital for both academic and non-academic organizations.

Knowledge and information have become the medium in which business problems occur. As a result, managing knowledge represents the primary opportunity for achieving substantial savings, significant improvements in human performance, and competitive advantage. Knowledge management can be thought of as the deliberate design of processes, tools, structures, etc. with the intent to increase, renew, share, or improve the use of knowledge represented in any of the three structural, human and social elements of intellectual capital (Haggie and Kingston, 2003). Hence, content management systems are specialised as typical data/information management systems and, as an evolutionized format, knowledge management systems (KMS).

Although these systems contain data, information and knowledge as content may also be ingredient of a learning/training environment when structured within a curriculum frame. Because any content in any form can not be interacted with students, new type of content manipulation and management systems are needed.

Unlike CMSs and KMSs, in learning content, there is plenty of content components to disseminate and interact with students: All concern is on shaping the content to the curriculum, organizing a learning environment for it or with it, considering learner profiles, arranging learning activities and planning evaluation schemes. Many LCMSs available in the market either provide features belongs to completely CMSs only or neglect the pedagogic spirit of learning content (Murray et al., 2003). There is therefore need to develop learning content management systems (LCMSs) which can embed and integrate interactive activities and other pedagogic components into the learning content package.

Authoring systems have become popular because of their object-oriented visualization approaches for programming and courseware development. Further rich template repositories added practicalities to authoring platforms (Elliott et al., 2002; Major et al., 1997).

However, when used in a comprehensive manner, the distributed nature of control flow and hidden actions make it more difficult for novices to form a mental representation of an object-oriented program than of a corresponding procedural program (Milne & Rowe, 2002). Similar findings were also reported in earlier research with program authors (Barr et al, 1999). Commercial companies provide, as they call, "zero-programming tools" that are aiming to solve some of the object-oriented programming difficulties. B

ased on the assumption that in developing software novices encounters many recurrent problem situations that require comparable solutions, new object-oriented design patterns provide standard solutions to common software development problems. That is software templates, claimed to provide support on the authoring; the templates offer pre-structured moulds of software and include different objects which may be higher level, empty lesson structures, default navigation methods, generic graphical user-interfaces and low level didactical objects (Boot, 2005).

It has been suggested that (Bell, 1999, Boyle, 2002; Merriënboer & Martens, 2002; Tripp & Bickelmeyer, 1990) instructional software templates may positively affect the efficiency of the development process and compensate for the developers' lack of experience. This can be beneficial for the authoring of instructional software because more people with low instructional design and software production skills are becoming involved.

PROBLEMS WITH DEVELOPING LEARNING OBJECTS

Unlike traditional authoring tools, LCMSs have a centralized content repository which resides on a server. This enables multiple users to easily share and re-use content, even if they are at different geographical location.

For example, if someone has already created an image, everyone authorized can search for it in the repository and insert it into a lesson without having to create it from scratch. This leaded into development of learning objects which is, according to the IEEE LTSC-LOMW Group (IEEE, 2005), an independent collection of content and media elements, hence it is a learning approach emphasizing interactivity, learning architecture and learning context (although some do free learning objects from context) and a metadata emphasizing storage methods and searchability (Barritt & Alderman, 2004; Yang et al., 2005). For context free and a granular structure of a learning object, and for the purpose of serving for more than one content area, each learning object should cover an instructional learning objective. However, instructional objectives in many learning tasks are not a few, but more than thirty.

Considering to prepare one learning object (LO) for each learning objective and to aggregate certain number of learning objects for a learning task may be a complex task for some. Once each objective of a learning unit is to be covered in a separate learning object, then it would not be possible to embed the entire learning unit into a story which would contextualize, concretize and proceduralize the content. Jonassen and Churchill (2004) also argue that reusable learning objects must be expanded to support the more complex interactions that are required for meaningful learning. Thus, a learning object should also be designed to enable accomplishing a set of instructional objectives.

Though there are many settlements on learning technologies and their specifications, there has been a fierce debate over one of the most cited standard, sharable content object reference model, (SCORM, 2004).

According to Rehak (2002), "SCORM is essentially about a single-learner, self-paced and self-directed. It has a limited pedagogical model unsuited for some environments." He emphasized that SCORM is not the right approach for higher and primary education. This is mainly a consequence of the needs of training institutions which is one of the main initiators of SCORM. Their needs are mainly in the area of training for specification. Wiley (2002) states that software vendors and standards-laying bodies describe their learning object related work as being "instructional theory neutral; however, many critics have challenged that assertion, claiming that the standards tend to ignore the importance of pedagogy. Other critics (e.g. Jonassen & Churchill, 2004; Parrish, 2004) believe that SCORM, far from being "pedagogically neutral" encourages a pedagogy that is behaviourist, didactic and instructive.

Further, Lee and Su (2006) state that SCORM doesn't have a conceptual model for modeling learning objects and for assessments in the object sequencing. Although the rationale and the structure of SCORM is not yet mature, the lesson for LCMS developers and/or LCMS seekers is to look for a system conformant to at least some of the SCORM requirements so as to help maturation of the standards and content exchange.

The IEEE LOMW Group has identified seventy-four categories under nine mainstream categories to describe the types of data contained in a learning object. This meta-tagging is tedious and many of those categories are unnecessary. That, in turn, does complicate the instructional design which is already a neglected process.

As teachers or adult learners will select learning objects by comparing them, meta-tagging with some seventy-four tags make it difficult to compare learning objects. Further, to stress another criticism towards existing learning object approach in LCMSs, Chapman and Hall (2004) reported that there are some dismal failures where learning content management technology has been completely misused or misunderstood; where technology designed to make modular learning content easily reusable has literally created a source of mass information overload, in which learning objects (topics) are linked together in sequences that don't make sense or provide misinformation when presented out of context, serving to confuse rather than educate. In some ways the technology has outpaced our ability to use it wisely. LCMS vendors continue to add innovative new feature sets, when most of us are still grappling with some of the basic concepts of learning object design.

Educational issues in learning objects are addressed in one set of categories with insufficient critical information about instructional interactions on the objects. The interactivity type classified as "active, mixed and expositive" are not taking the nature of learning into account sufficiently: The learner-learning object interaction could be so rich that it cannot be simplified.

On the contrary, the interactivity level is classified under five sub categories as very low, low, medium, high and very high. The categories of interaction type are expected to be more than categories of interaction level. It seems that interaction is only seen as physical manipulation of the objects, not the cognitive involvement.

A further mechanical approach to instruction and learning in metadata categorization is difficulty of a learning object. When difficulty of a learning object is tagged as "very difficult" which would then be studied by a student with necessary cognitive entry behaviors and skills, and who can easily connect existing knowledge to content of the learning object, would the learning object be still very difficult or would such tagging be meaningless? Learning objects are to help learning means that a

particular learning object is easy to learn and learning with that learning object would be easier, in this regard, tagging learning objects as difficult or very difficult would not be meaningful.

The metadata should focus more upon interactivity, cognitive involvement and functionalities of the learning setting. Jonassen and Churchill (2004) suggest multiple metadata describing a learning object as information, activity, conversation, knowledge, thinking and learning artifact objects, but this study suggests a different approach where rather than focusing on labeling, learner-content interaction should be the primary requirement and possibly the only standard; once learner-content interaction is met, practical tagging could be implemented.

They also argue that current conceptualizations of learning objects support traditional, objectivist forms of instruction; while there are no implicit restraints on the concept of learning objects in terms of their complexity, interactivity, and cognitive functionality, the current industry standards cannot describe the rich interactions necessary for meaningful learning, such as problem solving.

Therefore, in addition to being able to facilitate creating learning objects for individual learning objectives, there is need to explore that an LCMS with facilities to construct large in size and SCORM compliant learning objects may help online material developers.

PROBLEMS OF THE STUDY

The usage patterns of authoring tools and content development system facilities and benefiting from development systems to prepare a set of e-learning content may depend on the system users' experience with information and communication technologies (ICT). Cognitive and usability issues become paramount to the effective learning object development.

This study is in two folds, one discusses the design of a LCMS and provides a preliminary quantitative measure and second discusses evaluation of its impact on different type of authors' use of assets, organization of assets and instructional directions in a learning unit the authors created.

In this regard, the study aimed to examine novice and experienced ICT users' development of learning objects with different;

- **number of assets**
- **(picture, animation, simulation, sound file, hyperlink, game, video, downloadable-file),**
- **text density on each learning objects (small amount, moderate amount and large amount of text),**
- **number of instructional elements (advance organizers, questions and didactical directions), and**
- **number of screen orientations (sub-topics –Sharable Content Object (SCO)-, templates, picture orientation, font types and font sizes, colors, main topics) in their products.**

METHOD

Participants

To investigate whether the implemented system, BU-LeCoMaS, is easy to understand, to use and to maintain, the system was tested with 34 subjects (11 male and 23 female). The subjects were university students studying their third and fourth year in a school of education in order to be teachers of varying subjects from language to

high school mathematics. The participants contributed to the study in a voluntary basis.

They all studied courses like "Introduction to Computing" and "ICT in Education" before, hence familiar to information and communication technologies. When the subjects agreed to participate in the study, they were first provided with a username and a password to the BU-LeCoMaS server. Then they were taken to a computer lab where they also take some of their information technology courses. The lab was equipped with one server and 20 PCs organised in U shape in the room, all connected to the net. During their usage of the system, one of the researchers was present in the lab but did not intervene in the participants' work.

In one of their Educational Material Development course, the subjects were asked to use the system facilities and to construct a series of web based course for their chosen learning unit. They were instructed to use any sort of learning materials from video segments to static graphics, but they were free to use anything.

Materials: BU-Lecomas Learning Content Management System

To overcome the above mentioned disadvantages of content development and authoring platforms and to provide lecturers/trainers with the tools facilitating student learning, this study aimed to develop, an easy-to-use LCMS (BU-LeCoMaS) requiring content authors with little or no technology expertise and integrate it to an already in-house developed Learning Management System, BULMS (Akpinar, 2002).

The target system is able to accommodate dynamic nature of instructional content and learner needs. It therefore provides design and implementation teams with a software kernel structure to which teachers; designers and programmers can easily attach any content with small amount of effort. The architecture can handle and execute any content inputted. It, then, helps to integrate textual content, sound, movie and animations to software packages, and enabling multimedia platform creation.

Further it supports SCORM standards, allowing developed content to be used in different LMSs based on the idea of reusable learning content as sharable content object. In the LCMS this study develops, learning objects will be created however the system should allow and encourage developers to design and construct objects with which interactive learning environment features will flourish. The structure of the system, learning topic and learning unit organizations, will encourage users to design content based on a set of objectives as well as on activities. This study further explored and realized a LCMS with the following guidelines in mind.

- **All teachers can participate in the construction of new technology rich learning environments. Easy to use interface is needed.**
- **Teachers may need cooperation of other teachers in coping with students' learning problems. The LCMS should provide teachers/authors with facilities to take students' learning problems into account. The learning object metatagging should also be extended to cover experiences with a particular learning object. If there has to be tags associated to learning objects, tags should be about effectiveness of set of learning activities, learning objects or learning asset. Students' or trainees' reaction to learning materials are more informative to learning object seeker.**
- **Since available courseware packages alone may not meet adaptability requirements of students in different needs and teachers may need cooperation of other teachers in coping with students' learning problems the courseware packages should count teachers' intellectual capacity and provide teachers with collaboration tools to make courseware facilities fit to individual students.**

- Multiple users should easily collaboratively construct, share and re-use content within a LCMS as well as re-use after development. Reusable learning objects must be expanded to support the more complex interactions that are required for meaningful learning. Thus, a learning object should also be designed to enable accomplishing a set of instructional objectives. The size of learning object should be determined by authors.
- The learning object to be developed should be (1) objective based; activity based, but more importantly should allow learning by doing, (2) interactive and embed knowledge into story, hence contextualization is encouraged, (3) format free.
- The metadata should focus more on interactivity and cognitive involvement and functionalities of the learning setting,
- LCMS should help online material developers, time, place and platform independent content authoring should be facilitated.

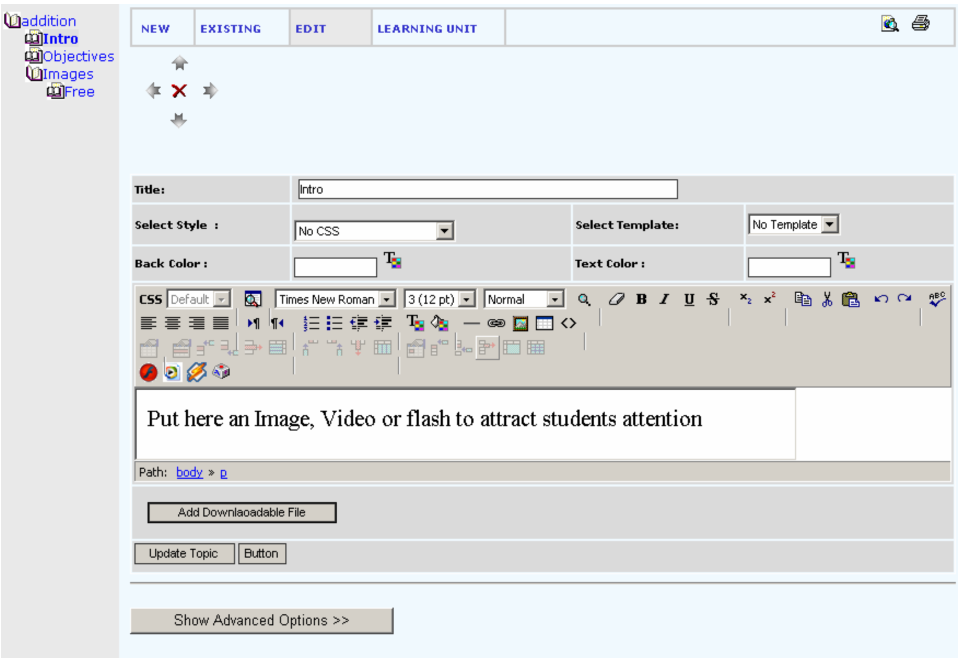

Figure: 1
A screenshot from BU-LeCoMaS: Editing object

In conventional learning environments, teacher plays an important role in determining what and how students learn throughout their activities.

Teachers are responsible for monitoring the flow of each student's activities, playing a meta-cognitive function for the students by probing their knowledge and reasoning, monitoring participation and student engagement. Student activities must be rich and needs based so that teachers make their educational diagnosis and intervention accordingly. As student needs vary and those needs may be fulfilled with different task regimes, it would be functional for teachers to have access to a large activity pool which is constructed and enriched by teachers. The BU-LeCoMaS accommodates such an activity pool managed within a global activity center.

Because Internet provides a means of easy communication and knowledge exchange platform, teachers can collaborate to construct and tailor task based upon their students' performance records. A set of online tools and resources support teachers as they, in turn, support the students through active process. This set of online resources outlines a suggested sequence of activities based on what has worked in

the past; each activity listed is linked to additional information regarding the purpose of the given activity, an elaboration of what the activity entails, and tips for when to intervene.

This set of resources provides a teacher with practical strategies for how to guide students' work. To accomplish these functionalities and to make them an internet communication medium, this study constructed a three module collaborative work platform for teachers: These modules, accommodated under a Global Activity Center (GAC), are Global Task Pool, Experience Repository and Learner Record Repository. An activity building community is to be achieved through fast communication means of Internet.

Then, colleagues experience sharing, a rich learners' profile and large number of authentic tasks may be realized. The productivity of interactions in the GAC is to a large extent dependent on the amount of time available for communication, number of teachers willing to cooperate and teachers' contributions to the pool. Design of GAC should encourage participant teachers to engage in developing meaningful practices through cooperative collaborative processes. The GAC will develop a climate where commenting on each others' work and giving and receiving feedback are integrated and routine part of the collaborators' work.

Creating a Set of Learning Content in the BU-LeCoMaS

To create a small set of learning content, an authorized author has to follow these steps:

1. **In the BU-LeCoMaS, learning materials are grouped to constitute a learning unit, size of which varies and depends on its author. The author clicks on the root icon, kernel of the system, to initiate creating a learning unit. In the root, the author may get a list of available learning units and learning topics; a learning topic is a subset of a learning unit. The BU-LeCoMaS supports both constructing a learning unit and constructing an asset, a granular learning content.**

2. **The author specifies the title and description of the material she is creating, selects a template, object type, tree view type, background and foreground colors, selects style sheet; selects to create as template or to share it as "public template", and decides to include it in the subject index of the BU-LeCoMaS. The subject index of the BU-LeCoMaS may be used by the system to search the object repository of the BU-LeCoMaS, or by the authors to manage associations of their materials for learning topics and units.**

3. **Once the author enters relevant information and selects, for example, LO template tutorial-1, the learning unit frame will be created. The author will then receive a screen where the name of her materials appears with four sub-sections, namely Introduction, Objectives, Images and Read & Study. The author may select any sections and designs (see Figure: 1).**

4. **The object order in the system is very hierarchical, once a LO template is used, the author may make modifications in the order of the learning topics, digital components of the unit. For example; in the template, LO template tutorial-1, the author is given four sections namely Introduction, Objectives, Images and Read&Study. The author may wish to re-order the sections and may want "Images" section to appear after "Introduction" section.**

5. **The author may use the editing palette to design and modify screen layout of each learning topic or asset. The edit palette contains facilities to edit text, picture, table, web page, hypertext and external file management including file insertion.**

6. Once the set of learning material is organized by the author(s), the author may wish to scormify and pack it. The BU-LeCoMaS handles these tasks as follows:

There are two facets of the implementation of the SCORM standard in a LCMS. One is the human side; the second is the machine (technical) side. Since the target group that will use the BU-LeCoMaS is neither computer engineers nor e-learning specialist [instructional designers] but university teachers, users' effort have to be minimal in both of these phases. SCORM uses some strict names like asset, sco, and learning object for the components of the e-learning content.

In the BU-LeCoMaS, in user interface part, these labels were converted into ones that are more understandable such as files, learning topics and learning units. Content organization of the learning object is provided manifests and sub-manifests in SCORM. In the BU-LeCoMaS, a tree view architecture is used to create and manage the content organization of the learning units. In order to provide a usable interface for the LCMS, some advanced SCORM tags are hidden under the "advanced" button.

In technical part, all tasks necessary to make a SCORM compliant content package may be accomplished by selecting "SCORM compliant" checkbox in the export menu. The system creates necessary SCOs as html files, and copies these SCOs and dependent files (images, multimedia and other files) into the same folder. In SCO files, necessary SCORM functions (LMSIntiliaze, LMSFinish and other custom functions) are written by the BU-LeCoMaS.

Then, imsmanifest.xml file which holds all information about content organization and metadata is created according to the learning unit database information and saved in the same folder with the SCOs. Lastly, JavaScript functions that are responsible from finding SCORM API and running other SCORM functions are created and saved.

The content package components should be bound in the form of a compressed archive file which is named the Package Interchange File and in the format of PKZip v2.04g (.zip) that is conformant to RFC1951 (SCORM, 2004). Thus, the LCMS may compress all content packages into a zip file and presents it to the user.

The design issues outlined in this work has been implemented through software tools including MS Visual Studio.NET (ASP.NET, C#.NET) Macromedia MX, XML and SQL Server. The Teacher source space in the system was constructed with asp.net and ado.net.

PROCEDURE AND DATA

When the participants completed a four hours (in two consecutive days) work with the BU-LeCoMaS, they were then given a usability questionnaire with 44 five-point likert type items and two essay items (five additional questions collected personal information). The scale was previously developed by Akpinar (2002) and used in testing a similar tool. Cronbach's Alpha reliability coefficient of the questionnaire was estimated in this study as 0,94.

The participants' responses to the usability questionnaire were converted into numerical values as their responses on the scale of each question: Strongly disagree: 1, Disagree: 2, Neutral: 3, Agree: 4, Strongly agree: 5. Then each participants' total system-usability score was estimated. The mean of those scores is 166,94 and the highest possible score is 220,00. The participants' products were closely examined by two researchers who counted the elements of the designed learning contents in terms of;

- **number of assets (picture, animation, simulation, sound file, hyperlink, game, video, downloadable-file),**
- **text density on each learning objects (small amount, moderate amount and large amount of text),**
- **number of instructional elements (advance organizers, questions and didactical directions) and**
- **number of screen orientations (sub-topics–Sharable Content Object-, templates, picture orientation, font types and font sizes, colors, main topics) in their products. SPSS Estimated Shapiro-Wilk coefficients (0,49 to 0,88) on the data sets showed that the data was distributed normally.**

The participants who self-perceived himself/herself as novice and the ones perceived experienced ICT user were compared on the basis of usability scores on the system.

According to the t test carried out on the participants' usability data showed (Table: 1) that ($t_{32;0,05}$=0,802) there is not a meaningful difference between the novice users' and experienced users' total usability scores on the system. The result indicates that the participants' average perception of the system facilities was positive in general. The current state of the most facilities was confirmed. However, there is a need for small amendments in the BU-LeCoMaS to satisfy users.

Table: 1
Comparing novice and experienced ICT users

Variable	UserType	n	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Usability test score	Novice	11	165,45	25,93	7,82	-,253	32	,802
	Experienced	23	167,65	22,66	4,72			
Text density	Novice	11	1,90	,53	,16	-,212	32	,833
	Experienced	23	1,95	,63	,13			
# of Inst. elements	Novice	11	1,36	1,43	,43	-,869	32	,391
	Experienced	23	2,82	5,44	1,13			
# of SCOs	Novice	11	2,18	1,53	,46	,076	32	,940
	Experienced	23	2,13	1,98	,41			
# of Templates	Novice	11	2,90	1,44	,43	,883	32	,384
	Experienced	23	2,47	1,27	,26			
# of Picture	Novice	11	4,27	3,52	1,06	1,117	32	,248

orientation	Experienced	23	3,00	2,64	,55	8		
# of Font formats	Novice	11	5,36	1,85	,56	,797	32	,431
	Experienced	23	4,78	2,04	,42			
# of Topics	Novice	11	5,72	2,10	,63	,042	32	,967
	Experienced	23	5,69	2,00	,41			
# of Colours	Novice	11	2,18	1,32	,40	,534	32	,597
	Experienced	23	2,00	,67	,14			
# of Main topics	Novice	11	3,54	1,57	,47	-,032	32	,975
	Experienced	23	3,56	1,75	,36			
# of Assets	Novice	11	15,54	27,77	8,37	1,136	32	,264
	Experienced	23	8,43	8,55	1,78			

***P<0.05**

Further t tests (equality of variances was checked) showed that the self perceived novice and experienced ICT users did not significantly (alpha=0.05) differ on using assets, instructional elements, amount of text and number of screen orientations in developing e-learning content.

The four groups' learning objects were then compared on the basis of their assets, instructional elements, amount of text and material organization in the screen orientation.

ANOVA tests (Table: 3) showed that the participants' use of assets, instructional elements, and material organization in the screen orientation at four types of content areas did not significantly differ, the only significant difference was observed at the font formats and amount of text, the post hoc tests on four groups'.

Data (Table: 4) showed that learning objects for science units had significantly (alpha 0,05) more font formattings than learning objects for social science units, but had less text density; other post hoc comparisons did not show remarkable differences.

Table: 2
Correlation matrix

	Mean	Std. Dev.	n	# of Assets		# of SCO		# of Pic. Or.		# of Topics		# of Color	
				r	p	r	p	r	p	r	p	r	p
# of Assets	10,73	17,14	34					,58**	,000			,64**	,000
# of Inst. Element	2,35	4,57	34			,45**	,007			,39*	,021		
# of SCO	2,14	1,82	34							,62*	,000		

									*			
# of Template	2,61	1,32	34						,34*	,047		
# of Picture Or.	3,41	2,96	34	,58**	,000							
# of Font Formats	4,97	1,97	34					,42*	,013		,35*	,042
# of Topics	5,70	2,00	34			,62**	,000					
# of Color	2,05	,91	34	,64**	,000							
# of Main topics	3,55	1,67	34	,34*	,045	-,34*	,046		,51**	,002		
Usability test	166,94	24,29	34	-,48**	,004						-,45**	,008

***P<0.05; **P<0.01: Sig. (2-tailed)**

In order to test whether uses of assets, instructional elements, and material organization in the designed LOs differ in contents, the participants' learning objects were grouped in terms of content fields as science, mathematic, social sciences and language.

The four groups' learning objects were then compared on the basis of their assets, instructional elements, amount of text and material organization in the screen orientation.

Science units had significantly (alpha 0,05) more font formattings than learning objects for social science units, but had less text density; other post hoc comparisons did not show remarkable differences.

Table: 3
ANOVA test for components of designed learning objects

		Sum of Squares	df	Mean Square	F	Sig.*
# of SCO	Between Groups	11,68	3	3,89	1,185	,332
	Within Groups	98,58	30	3,28		
# of Template	Between Groups	4,86	3	1,62	,915	,446
	Within Groups	53,16	30	1,77		
# of Picture Or.	Between Groups	5,56	3	1,85	,196	,899
	Within Groups	284,66	30	9,48		
# of Font Formats	Between Groups	37,13	3	12,37	4,044*	,016
	Within Groups	91,83	30	3,06		
# of Topics	Between Groups	13,05	3	4,35	1,088	,369
	Within Groups	120,00	30	4,00		
# of Color	Between Groups	3,21	3	1,07	1,304	,291
	Within Groups	24,66	30	,82		
# of Main topics	Between Groups	2,79	3	,93	,312	,816
	Within Groups	89,58	30	2,98		
# of Instr. Elements	Between Groups	46,51	3	15,50	,723	,546
	Within Groups	643,25	30	21,44		
# of Assets	Between Groups	980,45	3	326,81	1,124	,355
	Within Groups	8720,16	30	290,67		
Text Density	Between Groups	2,88	3	,96	3,203	,037
	Within Groups	9,00	30	,30		

$*P<0.05$;

Table: 4
Post Hoc Tests (Tamhane T2)

		Sum of Squares	df	Mean Square	F	Sig.*
# of SCO	Between Groups	11,68	3	3,89	1,185	,332
	Within Groups	98,58	30	3,28		
# of Template	Between Groups	4,86	3	1,62	,915	,446
	Within Groups	53,16	30	1,77		
# of Picture Or.	Between Groups	5,56	3	1,85	,196	,899
	Within Groups	284,66	30	9,48		
# of Font Formats	Between Groups	37,13	3	12,37	4,044*	,016
	Within Groups	91,83	30	3,06		
# of Topics	Between Groups	13,05	3	4,35	1,088	,369
	Within Groups	120,00	30	4,00		
# of Color	Between Groups	3,21	3	1,07	1,304	,291
	Within Groups	24,66	30	,82		
# of Main topics	Between Groups	2,79	3	,93	,312	,816
	Within Groups	89,58	30	2,98		
# of Instr. Elements	Between Groups	46,51	3	15,50	,723	,546
	Within Groups	643,25	30	21,44		
# of Assets	Between Groups	980,45	3	326,81	1,124	,355
	Within Groups	8720,16	30	290,67		
Text Density	Between Groups	2,88	3	,96	3,203	,037
	Within Groups	9,00	30	,30		

***P<0.05;**

DISCUSSIONS AND CONCLUSIONS

In the design of LOs for a chosen learning task, according to the data analysis, the self-perceived novice and experienced ICT users did not significantly differ at using;

- **number of assets (picture, animation, simulation, sound file, hyperlink, game, video, downloadable-file),**
- **density of text (small amount, moderate amount and large amount of text),**
- **number of instructional elements (advance organizers, questions and didactical directions) and**
- **number of screen orientations (sub-topics–Sharable Content Object-, templates, picture orientation, font types and font sizes, colors, main topics) in their LOs.**

Further, the tests based on subject categories of LOs, the participants' use of assets, instructional elements, and most material organization in the four types of content areas did not significantly differ. The only significant difference was observed at the participants' LOs was at the font formats and amount of text, the post hoc tests on four groups' data showed that learning objects for science units had significantly (alpha 0,05) more font formats than learning objects for social science units, but had less text density which may be due to the nature of subject matters that social sciences had more textual information than science tasks.

An interesting finding is that the users who found the system more usable employed more colors in the content organisation. The users who used more number of picture orientation on screens, also used more different font formattings and color. The number of templates and SCOs seems to be proportionaly used with topics and main topics. Similarly number of instructional elements seems to be proportionaly used with topics.

Surprisingly number of assets used in the LOs and the authors' usability test scores meaningfuly correlated, but there is an inverse relationship (r=-0,48), indicating that the users who found the system less usable embedded more content elements into their lessons than the ones who found the system more usable.

Similarly number of used colors and users' usability test scores meaningfuly correlated, but there is an inverse relationship (r=-0,45) between number of used colors and users' usability test scores, indicating that the users who found the system less usable embedded more color elements into their lessons than the ones who found the system more usable.

This may show that new users to an authoring environment would use facilities regardless of their level of acceptance of the system. Another inverse relationship (r=-0,345) is between number of sharable content objects and number of main topics (files) in organised lessons. That may be a result of structuring one large learning object with many small sized content objects. This finding may support the idea of aggregration of content objects in any learning objects is possible and may be achieved by authors at different level of ICT users.

In contrast to Boot's (2005) findings with users in a commercial authoring environments, the groups who used the BU-LeCoMaS did not differ significantly at the average number of information elements used in their software and the number of different types of question elements. Further, the provided templates did not entirely restrict the developers' creative freedom, because in addition to templates the users employed other instructional elements. The different result may be due to the fact that the BU-LeCoMaS did not have as many facilities as commercial authoring systems have.

This study agrees with Tripp and Bickelmeyer (1990) that instructional software templates may positively affect the efficiency of the development process, templates may be alternatives but the findings suggests that easy-to-use systems may also be designed to support less experienced ICT users' efficient development process. These findings do not show that when authors use more assests in their LOs or do different number of screen orientation in their LOs, the LO design would be better.

But they show that the designed learning content management system is easy for everyone including novices to design different LOs. In other words, one might argue that it is not the quantity/amount of screen objects in a LO which make LOs interactive, this study is aware of it, but the study aimed to confirm that the content development is managed by even novice ICT users and design of interactive LOs is another issue to be studied within particular learning tasks.

The study showed that novice and experienced users may develop small and large size learning objects at different content areas. Usage patterns of facilities of e-content development systems and benefiting from development systems to prepare a set of learning content is not dependent on the system users' experience with information and communication technologies. People do not seem to approach creating e-learning content from a pedagogical or technical perspective but their conventional and ordinary conception of e-learning design is more dominant. The study concludes that simple design and unexaggerated number of facilities would enable both novice and experienced users in developing learning objects including SCORM compliant type.

Recently, there have been many research efforts to transfer the technology of authoring tools and intelligent tutoring systems over the Internet. However the development of such educational programs is a hard task that needs much effort from domain and computer experts. Since available courseware packages alone may not meet adaptability requirements of students in different needs and teachers may need cooperation of other teachers in coping with students' learning problems, the courseware packages should count teachers' intellectual capacity and provide teachers with collaboration tools to make courseware facilities fit to individual students..

In this work, we have presented the development of a set of facilities that focus on the issues of building virtual environments in a user-friendly and open manner in the World Wide Web. To do so we have exploited an object-centred approach of virtual environments and represented them in terms of a set of composed objects.

This allowed users to share experiences and collectively build learning objects. The BU-LeCoMaS targeted here did not replicate all features of commercially available authoring systems, however, it will extend rather than replace capabilities afforded by such systems, and allow additional level of concreteness and modularization for producing a learning environment.

Because making a learning object scorm-compliant is difficult, this study, along with meeting SCORM requirements, adapted a different approach. The approach aims to ease the task of tagging learning objects with more realistic, meaningful and practical information sets. The approach also enabled teachers to work together in creation of those tag information which will pedagogically define a learning object set and its performance data.

To accomplish these functions, this study constructed a three module collaborative work platform for teachers: These modules, accommodated under a Global Activity Center, are Global Task Pool, Experience Repository and Learner Record Repository.

The framework of supporting students through teachers' collaborative course authoring, considering the different backgrounds of the students and preferred teaching/learning style of teachers/students, should be further evaluated using different task regimes in different subject matter areas. Creation of different type of learning objects in the system and supporting those LOs with user feeback are now under investigation.

Acknowledgement: This research was supported by Bogazici University Scientific Research Fund under Grant no: 04D201.

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