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A systematic evaluation of preservice teachers' opinions on learning objects

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Abstract

The purpose of this study is to investigate preservice teachers' opinions on Learning Objects (LO) in teaching and learning. 'LOs Perception Questionnaire' was developed and applied among preservice teachers. The survey consisted of four parts: "Merit of LOs'', "Use of LOs", "Accessing LOs", and "Developing LOs". The study included 336 preservice teachers from art, math, computer, and elementary education. Before the survey, participants took a three-hour learning module on LOs and repositories. The module included a one-hour teacher lecture, a one-hour web-quest, and a one-hour class discussion on LOs. Results indicated that instead of valuing, accessing, and using LOs to merely deliver content, it seemed more challenging for preservice teachers to know how to develop them for teaching and learning.

Keywords: Learning object, repository, preservice teacher, perception

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Introduction

Properties of Learning Objects

Definition of Learning Objects (LOs) is murky and it has been used to describe either digital or non digital materials which help students to learn content. Although the concept of learning object attracted a lot of research and discussions, research clearly shows that there is not general agreement on a definition of learning object (Polsani, 2003). Researchers underline important properties of LOs which are being content specific, interactive, reusable and accessible on the Web (Table 1). IEEE-LTSC(2002), Van Zele, Vandaele, Botteldooren & Lenaerts (2003), Wiley(2001), and Allert, Richter & Nejdl (2004) described learning object as "any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning". A learning object is a "self-standing, reusable, discrete piece of content that meets an instructional objective" (ADL, 2002). According to Alonsoa, Lópeza, Manriquea & Viñes (2008), a learning object is the specific knowledge that a learner has to acquire about a concept or skill and the tasks to be performed. Gadanidis & Schindler (2006) narrowed the definition and described LOs as small interactive programs that are available online and are focused on specific content topics. Chrysostomou & Papadopoulos (2008) expressed the reuse of LOs and defined LOs as self-contained chunks of learning content that can be reused in a variety of learning contexts. Kay & Knaack (2007) focused on interactivity and defined LOs as "interactive web-based tools that support the learning of specific concepts by enhancing, amplifying, and guiding the cognitive processes of learners". Moreover, LOs are instructional materials found on the Internet that can be used to illustrate, support, supplement, or assess student learning (Cramer, 2007).

Table 1. Properties of LOs

	Content Specific	**Reusable**	**Interactive**	**On the Web**
Alonsoa, Lópeza, Manriquea, & Viñes (2008)	X			
Chrysostomou & Papadopoulos (2008)		X		
Kay & Knaack (2007)	X		X	X
Cramer (2007)				
Gadanidis & Schindler (2006)	X		X	X
Allert, Richter & Nejdl (2004)		X		
Van Zele, Vandaele, Botteldooren, & Lenaerts (2003)	X	X		
Wiley (2001)	X			
IEEE-LTSC (2002)	X			
ADL (2002)	X	X		

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Types of LOs

Rhetoric issues on the definition, use, structure and components of LOs bring the issue to how many types of learning object could be in literature. In this regard, the best developed category of LOs is Wiley's taxonomy (2000). Wiley (2000), in his taxonomy, categorized five types of LOs which are fundamental (a document or a picture), combined-closed (a video accompanying with audio), combined-open (a web page including documents, pictures, movies which can be uncombined), generative-presentation (a JAVA applet including some kind of user interaction and capable of graphically generating a set of problems to students), and generative-instructional (any interactive tool which provide instruction and practice to students). Merrill (2002) classified LOs as entities, actions, processes, and properties. Redeker (2003) focused on didactics aspect of LOs and group them into receptive (the learner in the role of only consuming information), internally interactive (human-computer interaction), and cooperative (communicative activities of learner such as braisnstorming, debating, problem solving). Dolphin & Miller (2002) identified three types of LOs: generative (objects which produce interactions), connective (objects which can be connected together to produce richer interactions), and adaptive (providing for example, enhanced accessibility where appropriate by accessing a student profile). In Magenheim & Scheel (2004), two types of LOs were defined: closed and open. Additionally, the OSEL Taxonomy (Convertini, Albanese, Marengo, Marengo & Scalera, 2006) which focused on the intrinsic characteristics of the LO and the interaction with the user, can be taught as combination of Wiley (2000)'s and Redeker (2003)'s taxonomies. The types of LO individuated in the OSEL Taxonomy are nine: B-simple, B-Passive, B-Active, T-simple, T-passive, T-active, W-simple, W-passive, W-Active.

Merit of LOs

With the increase of computer-aided teaching tools, the preparation and use of instructional materials in electronic media have been adopted more quickly than other materials and it was noticed that update of prepared materials was quicker. In particular, the spread of internet technology has also showed its effect in the field of education and prepared materials and other tools on the Internet began to spread quickly. Written and visual materials known in the traditional sense have been replaced by electronic materials in environments such as the online learning, blended learning, the much mentioned today. In particular, the participation of the student's learning process has become more active with

new approaches such as email, chat room, forms, information and resource sharing, and with the use of materials like audio, video, animation, pictures, etc., learning and teaching phenomenon has taken different dimensions.

Digital LOs, similar to written and visual materials, are assets that have learning goals and features in their own properties. In contrast to written and visual materials known in the classical meaning, digital LOs are designed as desired, and updated and re-used easily which are important features. Reuse at the same time is shown as the most significant difference and everyone reach the digital LOs simultaneously. However, it is quite difficult, even impossible to provide this feature by using other materials (video tapes, audio tape, etc..). Since LOs are small pieces and each piece is designed as a means to express itself, more than one learning object can be brought together and used as appropriately according to learning goal.

LOs developed by a standard (SCORE, IEEE standards, etc..), whoever the developer is, are able to work in all kinds of Learning Management Systems (LMS) and this feature makes LOs special. Because of this feature, LOs are presented as an alternative to existing lack of materials. LOs developed according to SCORM standard are called as Sharable Content Objects (SCO) and can work in any environment and different platforms compatible with SCORM standards.

LOs are seen as one possible solution to the lack of learning materials and e-learning cost problem. According to Weller (2004), LOs can address the dilemma of high fixed costs of production in e-learning in four ways: reuse, rapid production, ease of updating and cost effective pedagogy. Similarly, Chrysostomou & Papadopoulos (2008) indicated that LOs can easily be aggregated to form larger learning contents, which can also be reused when necessary and LOs have the ability to be used in a variety of contexts. In this sense, teachers can use LOs in a variety of teaching styles or apply to them their own preferred styles. Moreover, it is obvious that as digital sources providing interactivity, LOs become more appealing to teachers and consequently to students.

Accessing LOs

In most cases, LOs produced are stored in places called learning object repositories. Generally, repository of assets and LOs are stored together, but in some cases, content also is stored in the repositories. Many LOs, in regard to learning object repositories, physically do not host the repositories. Instead, clicking on the desired link of LOs stored in another

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location allows searching results and reaching the learning object repository metadata (data about data). This feature does not apply to whole repositories. According to the size of the organization or of the institution, repository of assets and Sharable LOs (SCO) can be used as a separate repository. Many repositories are open to only members of the institution; everyone is forbidden to access to the repository In other words, today, while some learning object repositories are open to public, some work as a private for people or institutions.

Merlot, Careo, Wisc-online, Iclass, Adaptive curriculum, CanLOM Knowledge Agora, Edusplash are some of the learning object repositories. Merlot is one of the best known open learning object repositories. It offers an organized, streamlined, and timesaving way to find good digital materials for teaching and learning. Brinthaupt, Pilati & King (2008) presented an overview of MERLOT, described the peer reviewing of materials and highlighted resources found in its catalog. The MERLOT provides instructors with a wide range of teaching materials, resources, and tools as well as guidelines for the creation of digital LOs. In addition to that, Ally & Cleveland-lnnes (2006), in their study, evaluated three learning object repositories. The purpose of the study was to explore learners' motivations for searching through a repository and selecting LOs and to identify learners' perceptions of a quality repository. 16 participants were invited to select and evaluate LOs from at least one of three learning object repositories for customer-service-related LOs. Two chose to review Edusplash, three chose CanLOM Knowledge Agora, and 11 investigated the Wisconsin Online Resource Center.

Connection to teacher education

In the framework of technology integration, it is inevitable to emphasize the importance of the teacher factor. Thinking about the direction of technology, dissemination (diffusion), adaptation (Rogers, 1995) and implementation of innovation mostly depends on teachers' adoption of new innovations; briefly on their personal and individual meaning on these new technologies (Fullan, 1991). Research clearly shows that on the issue of teachers' technology use in the classroom, teachers form their own principles, ideas and judgments, and all of these may affect their applications in the classrooms (Cope & Ward, 2002; Jedeskog & Nissen, 2004).

In regard to effective integration of technology in the process of learning and teaching, a research conducted with 114 teachers has indicated that 109 (95.6%) teachers were effectively using computers to teach, while 5 (4.4%) did not use the computer at all

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(Demiraslan & Koçak-Usluel, 2005). Regarding level of technology usage, advanced level teachers have used "Word Processor", "www" and "e-mail" in their applications; "Calculation Sheet", "Educational Software CDs" and "Presentation of the program" were specified as the middle level of use in applications; and teachers indicated they almost never use the applications like "Desktop Publishing programs", "Database programs", "Graphics and drawing programs,". Results showed although teachers use the computers, the process of technology integration was not found in any event of teachers' learning and teaching process.

Another study conducted by Usluel, Mumcu, & Demiraslan (2007) used 590 teachers working in TEP schools in which the Information Technology Classes established. Looking at the research results, it seems clear that there are significant differences between teachers receiving no education about the use of technology in lessons and other teachers received training in terms of technology use in learning-teaching process.

Studies conducted on spread of technology in schools expressed that technology use in schools were limited to administrative purposes; however dissemination in instructional use are in initial phase yet (Pelgrum, 2001). In general, teachers have positive feelings to use technology integration in courses, but they do not show and perform this integration (Usluel, Mumcu, & Demiraslan, 2007). Thinking about barriers preventing teachers' technology integration in the classrooms, after lack of technology, lack of information and inadequate in-service training explains why teachers do not use technology in classes, although they have positive feelings. In this regard, the common point made by most studies attracts the attention that condition of necessary skills and knowledge of the teachers is the primary reason of effective technology integration in learning and teaching process (Cope & Ward, 2002; Jedeskog & Nissen, 2004). For example, regarding barriers and facilitating factors affecting the development and use of learning objects in developing instructional materials and their use in supporting individualized learning, Moisey, Ally, Spencer (2006) identified three facilitating factors (exemplars, online resources, and evaluation assistance) and nine barriers(definitional, work involved and skill deficits, structure of repositories, lack of learning objects in some disciplines, quality of learning objects in repositories, granularity, metatagging and cataloguing in repositories, copyright and intellectual property, and attitudinal barriers). The study results showed that the successful development and use of learning objects will be promoted by overcoming the barriers and strengthening the facilitating factors identified in this study.

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By connecting the ideas from LOs and current research on teachers' use of technology, this study will investigate how preservice teachers see LOs and what kind of experiences and feelings they have on LOs. Empirical research providing teachers' opinions on LOs is missing in research. However, it is obvious that implementation and integration of technology mostly depends on teachers' opinion on technology. Thus, it is vital to identify preservice teachers' opinions and beliefs on LOs. Since the literature suggests that by using LOs, classes can be modified according to students' learning needs and benefits of LOs are so obvious, it is important to examine preservice teachers' feelings and understanding on LOs and whether production of LOs are affected by perceptions of preservice teachers.

Method

The purpose of this study is to explore preservice teachers' opinions on LOs in teaching and learning. The study included 336 preservice teachers from art, math, computer, and elementary education departments. Participants took a three-hour learning module on LOs and repisoteries. The module included a one-hour teacher lecture, a one-hour web-quest, and a one-hour class discussion on LOs. After the module completed, participants filled out the questionnaire. The participants consisted of 115 male (%34) and 221 female (%66) who are from computer education (64, %19), art education (26, %8), mathematics education (106, %31), and primary education (140, %42).

The questionnaire was developed by examining the literature, writing items, and obtaining expert views. The scale of the questionnaire is a 5-point likert type: 1: definitely do not agree, 2: do not agree, 3: unsure, 4: agree, 5: definitely agree. The questionnaire was piloted among 274 preservice teachers to determine underlying structures exist for measures on 20 variable by an exploratory factor analysis. Principal component analysis was conducted utilizing a varimax rotation. The analysis produced a four-component solution, which was evaluated with eigenvalue, variance, scree plot, and residuals. Criteria indicated a four-component solution was appropriate. After rotation, the first component accounted for 40.49% of the total variance in the original variables while the second component accounted for 17.23%, the third component accounted for 8.39%, and the forth component accounted 4,83%. Table 2 shows the loadings for each component. The first component consisted of 9 of the 20 variables. These variables have positive loadings and addressed as "Merit". The component number two included 3 variables labeled as "Use". The third component included

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4 variables labeled as "Access". Finally, the forth component included 4 variables labeled as "Develop". Test reliability was assessed by calculating Cronbach's alpha. The analysis produced a coefficient of 0, 90.

Table 2. Component loadings

Component		**Loading**
Merit	Using LOs in teaching and learning is a good idea.	,726
	LOs are good tools in teaching and learning.	,696
	LOs are good innovations for teaching and learning.	,704
	LOs made my learning on course content easy.	,724
	LOs are beneficial in my learning.	,784
	LOs made my learning more effective.	,797
	LOs will appeal the interest of my students.	,850
	LOs will help my students' learning.	,844
	LOs will ease my profession.	,850
Use	We use LOs in our classes frequently.	,852
	We use LOs in our classes properly.	,883
	We use LOs in our classes effective.	,852
Access	I know what a learning object repository is.	,786
	I know how to access a learning object repository.	,812
	I know how to benefit a learning object repository.	,671
	I know how to access LOs.	,617
Develop	I know how to use LOs in teaching.	,671
	I know how to develop a learning object.	,576
	I have enough knowledge to develop LOs.	,587
	It is easy to develop LOs.	,509

An additional part of the questionnaire, also, included items stating participants' agreement on the type of LOs which they used in their college courses. Types included text, picture, slide, graphic, web page, video, animation, manipulative, interactive, and combined LOs. Test reliability was also calculated by Cronbach's alpha for these items and produced a coefficient of 0, 86.

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Findings

The data were analyzed by calculating mean scores on items and components. Group differences were analyzed by running analysis of variances according to gender and subject areas. The data on the type of LOs used in the classroom were also analyzed by calculating mean scores.

Mean scores by test items

Table 3 shows that participants perceive LOs will ease their profession ($M_{İtem\ 26}$=4, 46); appeal the interest of students ($M_{İtem\ 19}$=4, 49); and help them learn ($M_{İtem\ 20}$=4, 50). However, they are unsure if they use LOs in their university classes frequently ($M_{İtem\ 7}$=3, 05), properly ($M_{İtem\ 8}$=3, 04), and effectively ($M_{İtem\ 9}$=3, 16). Similarly, participants are unsure whether they know how to develop LOs ($M_{İtem\ 17}$=3, 01).

Table 3. Mean scores by items

Items	Mean (M)
1. Using LOs in teaching and learning is a good idea.	4,45
2. LOs are good tools in teaching and learning.	4,38
3. LOs are good innovations for teaching and learning.	4,39
4. I know what a learning object repository is.	3,73
5. I know how to access a learning object repository.	3,66
6. I know how to benefit a learning object repository.	3,55
7. We use LOs in our classes enough amount.	3,05
8. We use LOs in our classes properly.	3,04
9. We use LOs in our classes effectively.	3,16
10. LOs made my learning on course content easy.	4,16
11. LOs are beneficial in my learning.	4,25
12. LOs made my learning more effective.	4,18
13. I know how to access LOs.	3,65
14. I know how to use LOs in teaching.	3,61
15. Use of LOs is easy.	3,79
16. I know how to develop a learning object.	3,12
17. I have enough knowledge to develop LOs.	3,01
18. It is easy to develop LOs.	3,20
19. LOs will appeal the interest of my students in the future profession.	4,49
20. LOs will help my students' learning in the future profession.	4,50
21. LOs will ease my profession.	4,46

Mean scores by components

Table 4 shows the participants' agreement with the idea that LOs are valuable tools for learning (M_{Merit}=4, 36); and they can access them (M_{Access}=3, 92). However, they are not

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sure about their use of LOs in the university courses (M_{Use}=3, 01) and whether they can develop them ($M_{Develop}$ =3, 34).

Table 4. Mean scores by components

Components	Mean (M)
Merit	4,36
Use	3,01
Access	3,92
Develop	3,34

Comparison by gender

A one-way analysis of variance revealed significant differences between male and female on use, F(1, 334)=5.59, p=.019, and development of LOs, F(1, 334)=7.45, p=.007. Mean scores shows that males score higher than do females on use and development (Table 5).

Table 5. Mean scores by gender

	Merit	Use	Access	Develop
Male	4,26	*3,38	3,70	*3,70
Female	4,39	3,13	3,73	3,46

*The mean difference is significant at the .05 level

Comparison by subject areas

A multi-way analysis of variance revealed significant differences among participants' subject areas in terms of opinion on merit, F(3, 332)=4.90, p=.002, access, F(3, 332)=4.69, p=.003, and development F(3, 332)=10.80, p=.001. Multiple comparisons were calculated by bonferroni post hoc adjustment (Table 6). The results showed that participants from computer education scored higher on "develop" than did all the remaining. Participants from art education scored less on "merit" than did all the remaining. Participants' opinion on the use and access of LOs showed unsignificant difference depending on participants' subject areas.

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Table 6. Mean scores by subject areas

	Merit	**Use**	**Access**	**Develop**
Computer	4,44	3,33	3,73	*4,15
Art	*3,93	2,82	3,59	3,14
Math	4,38	3,15	3,95	3,54
Elementary	4,42	3,28	3,57	3,42

*The mean difference is significant at the .05 level

Types of LOs used in the classroom

Table 7 shows participants' mean scores on the type of LOs used in their college courses. Participants perceive text as the only type which are surely used it in their classes. Picture, slide and graphic are the types that the participants are between unsure and agree about if they enough use. Web page, video, and animation are the types that the participants are unsure about the use. On the other hand, results present that the participants do not agree that they are using manipulative and combined LOs.

Table 7. Types of LOs used in the classroom

Type of LOs	**Mean**
Text	4,35
Picture	3,67
Slide	3,66
Graphic	3,11
Web page	2,92
Video	2,79
Animation	2,60
Manipulative	2,54
Combined	2,39

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Discussion

LOs have increasing potentials to be used in teaching and learning because they appeal learners' interest and increase learning by the use of digital technologies allowing various ways for organizing, presenting, applying and evaluating information. Results of this study indicated that the preservice teachers perceive LOs helpful for learning and teaching and preservice teachers believe that LOs will appeal interest of their students.

The repositories that hold the learning objects have well researched user interfaces and architectures that make them easy to use and permit various levels of interactivity including search, submissions, comments/reviews, and creating personal collections. The results of this study indicate that preservice teachers can access and use these repositories.

It is critical to build technology using faculty to facilitate technology using teachers. However, the participants are unsure if their use of LOs is enough in the college courses. Therefore, technology should be integrated across the curriculum of teacher education programs. It is clear that if student teachers are to use technology effectively for teaching in the future, they must use it for learning while they are students and that the instructors should be role-models by integrating technology into their instruction.

The participants are not positive about their ability to develop LOs except for developing texts, pictures and slides. In other words, preservice teachers have a tendency to use only fundamental learning objects like text and image. The findings of this study regarding using different types of LOs support the previous findings. Results of such studies (e.g., Pelgrum (2001)) showed that teachers are stuck with low level of technology usage. Results clearly show that although preservice teachers value and access learning objects, their development and usage of LOs are initial phase (Table 4). Additionally, the results of this research suggest that high level of learning objects (animation, video) should be used in teacher education, according to preservice teachers' needs and experience on using the LOs. Rather, what level teachers are on the LOs, and how strong their knowledge and their familiarity with LOs seem makes difference. Thus, it is essential that teachers should become more aware of features of LOs that might affect their enthusiasm and curiosity on usage and development. Moreover, faculty must focus on developing preservice teachers' experience with LOs through class activities. Computer applications that preservice teachers need to develop knowledge on could be scripting languages like Javascript and ActionScript and applets like Java applets and Flash movies.

The results of the study indicate that there is a relation between teachers' subject area and teachers' development of LOs (Table 6). Actually, this result supports the findings of Moisey, Ally, & Spencer (2006) in which it was found that the development and use of learning objects relates to the discipline itself. From this study, it seems that teachers from computer department are more willing to develop learning objects. Thus, it is clear that teachers' familiarity and experience on the use of computer clearly affects students' perception on LOs. Faculty should use such learning objects according to students' expertise on the LOs and develop new strategies that might catch interest, curiosity and enthusiasm because, for example, teachers from art department seemed to value and use the LOs low than teachers from other departments. It seemed clear that effective use of learning objects in classrooms would be expected from all teachers who have positive value and high experience on the LOs. The descriptive results in the study clearly show that gender also makes difference in teachers' use of the LOs (Table 5). Therefore, more research on gender, attitude, and experience in LOs is needed to understand how teachers work with the LOs and use them as learning tool in the class environment.

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