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# Should K-12 Teachers Develop Learning Objects?

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## Abstract

The emergence of learning objects for teachers as a focus of educational concentration is relatively new and much of the discussion has not been based on the actual development of objects, but different definitions, learning theories, properties and standards or decorative packages of learning objects (LOs). Also, in many teacher education programs, prospective teachers take a computer literacy class separate from content methods classes and rarely engage in producing authentic teaching/learning experiences. This research goes somewhat to address prospective K-12 teachers' development of learning objects. In this study, a group of prospective K-12 science teachers' learning objects were examined, evaluated and compared with LOs developed by instructional designers (IDs). A total of forty learning objects were closely investigated and effectiveness of eight of them was tried out with 180 target students in classrooms. Detailed analysis of the LOs demonstrated that while both the preservicers and the IDs use similar number of instructional elements in their LOs, the IDs seem to represent concepts and procedures with screen objects other than the text and used the text for supporting graphical objects. Both groups developed LOs similar in quality measured with the LORI 1.5. Statistical tests on the data obtained from classroom usage of the LOs showed marked improvements in the students' learning.

**Keywords:** Learning object, prospective teachers, development, evaluation

## Introduction

Teachers are responsible for tailoring instructional activities to meet curriculum standards and the unique interests and educational needs of their students. E-learning systems replace the teacher as the center for learning, the teacher role shifts from lecturer to that of course developer and, once a course is in session, the learning facilitator (Cohen & Nycz, 2006). As the use of digital learning objects as an instructional aid for teaching via technology becomes more widespread in educational settings (Conceição & Lehman, 2003), most of the research literature on learning objects has focused on the specifications and potential designs of learning objects, even National Educational Technology Standards for Teachers does not require teachers develop their technology based learning resources, but asks to use those facilities. Also it is often said that we don't expect every teacher to write their own textbook, why should we expect them to design their own technology based materials? (Bratina et al., 2002). However, Ainsworth and Fleming (2006) reply this question and argue that all teachers do customize their textbooks to use in their classroom by suggesting an order to read chapters, explaining difficult terms, providing exercises and worksheets, they then propose that much can be gained by providing teachers with simple authoring tools. Other researchers suggested that (Boyle, 2003; Merriënboer & Martens, 2002) 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. Further, teacher involvement in the development of online learning resources has received attention only recently (Akpinar & Simsek, 2006; Muirhead & Haughey, 2005; Recker et al., 2005) and researchers (Dunning et al., 2004; Jones, 2004) have suggested that with the addition of simple templates, teachers will be able to make their own objects. While a number of design features have been incorporated by developers of learning objects in the literature, only a few studies did a formal descriptive evaluation of the final learning object (LO) product (e.g., Krauss & Ally, 2005), there are not enough number of studies examining impact of learning objects developed by teachers on students' achievement .

## Problems of the Study

This research studied preservice science teachers' development of LOs in a learning content management system (LCMS) and compared those with instructional designers' LO development. In this regard, the study aimed to (1) compare preservice science teachers' and IDs' development of K-12 science LOs with different (a) number of assets (picture, animation, simulation, sound file, hyperlink, game, video, downloadable-file), (b) text density on each learning objects (small, moderate and large amount of text), (c) number of instructional elements (advance organizers, questions and didactical directions), (d) number of screen orientations (templates, picture orientation, font types and font sizes, colors, main topics, sub-topics –Sharable Content Object (SCO)) in their products, (e) the quality of LOs using the Learning Object Review Instrument (LORI, v.1.5 by Nesbitt & Li, 2004), and (2) to investigate the effect of LOs with the targeted students in real classroom environments.

## Method

To investigate preservice science teachers' development of LOs in a LCMS, a series of studies were conducted with 40 subjects (20 preservice science teachers and 20 newly graduated instructional designers). The materials of this study included "Instructional Materials Development course, a LCMS, BU-LeCoMaS, the learning objects for K-12 developed by the subjects using the BU-LeCoMaS, LO Review Instrument and achievement tests used in pre and post testing of K-12 students' achievement. The preservice science teachers followed a thirteen week study in the Instructional Materials Development course focusing on the development, implementation and evaluation of ICT based instructional materials and special emphasis was also given on the properties of learning objects. It is a four-hour per week course (two hours theoretical and two hours practical activities), the subjects were given opportunities to have intensive experience in web based learning materials; some of their learning activities in the course was based on developing online support materials and web sites in a commercial web editor to assist K-12 students' learning a set of learning content. The course covered hands-on activities to define a site, create tables, insert images, create links, manipulate text properties, test links, make a site accessible, and publish a website. It then covered the fundamentals of Flash to import assets, create keyframes and simple animations, build buttons and navigation elements, incorporate sounds that respond to user actions and publish a movie. When the preservice science teachers completed their course, both the instructional designers and the preservice science teachers were first provided with a username and a password to the BU-LeCoMaS server and taken to one-hour training about use of the BU-LeCoMaS. The training was carried out in two sessions. After the training, they were instructed to select a K-12 science learning task and prepare and bring their materials to the lab, assets of learning objects in a week time, as they will aggregate those materials and develop learning objects for K-12 science students: They were asked to use any sort of learning materials, assets, from text to animations and from static graphics to video segments, allowed to reuse graphics borrowed from Internet.

In the following week, the subjects were asked to use the system facilities and to develop a set of web based materials organized as learning objects for a part of their chosen K-12 science learning unit, covering enough materials to be studied within a lesson hour. During their usage of the system, one of the researchers was present in the lab for possible technical problems but did not intervene in the participants' work. Each participant developed one learning object, a total of forty, in K-12 science. Following the participants' development of learning objects for K-12 in two consecutive days, one for preservicers and one for IDs, 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) in order to measure the usability of the content development system, BU-LeCoMaS. The scale was previously developed and used elsewhere (Akpinar, 2002) and used in testing usability of a similar tool, and had reliability evidence (Cronbach's alpha: 0.91).

## *Review of the Learning Objects and Data*

To identify patterns of the forty learning objects developed, they were closely examined by the two researchers. The reviewers studied the LOs and then counted elements of the designed learning objects in terms of (1) number of assets (picture, animation, simulation, sound file, hyperlink, game, video, downloadable-file), (2) text density (small amount, moderate amount and large amount of text) on each learning object, (3) number of instructional elements (advance organizers, questions and didactical directions) and (4) number of screen orientations (sub-topics – Sharable Content Object (SCO)-, templates, picture orientation, font types and font sizes, colors, main topics) in the LOs. To establish a learning object repository for various levels requires criteria to assist teachers develop, submit and assess LOs (Akpinar & Simsek, 2006). These criteria are crucial to ensure the quality of resources and maintain a repository. For that purpose, Nesbit and Li (2004) developed a Learning Object Review Instrument (LORI 1.5) that this study employed because its developers provided evidence that LORI can be used to reliably assess some aspects of LOs.

In order to evaluate the LOs developed by the preservice science teachers, two researchers reviewed and rated the 20LOs individually using LORI scoring sheets. Then, the researchers combined the ratings and estimated average ratings both for each of nine issues for a particular LO and for overall rating of that LO. The reviewers' overall ratings for a LO was obtained through summing up points given to each nine issue for a particular LO. Next, the LOs developed by the control group, IDs, were made available in a web server to the IDs who reviewed and rated their twenty developed LOs independently using the LORI; the twenty IDs' ratings were averaged. The two researchers who rated the preservicers' LOs also rated the IDs' LOs. The correlation between the researchers rating and the IDs' rating was high enough (0.96), thus two ratings were combined with the twenty IDs' ratings and the average constituted ratings of the control group's LOs.

To test whether the preservice science teachers' and IDs' LOs are meaningfully different in terms of number of assets, amount of text, number of instructional elements, number of screen orientations and quality, (Skewness and Kurtosis measures showed that the data was not distributed normally) the Mann-Whitney U tests were conducted on the groups' data. The tests revealed that (a) The preservice science teachers used meaningfully less number of assets in their LOs than the IDs ($U=116.50$; $p=0.024$); (b) The preservice science teachers used meaningfully more amount of text in their LOs than the IDs ($U=102.50$; $p=0.003$); (c) The preservice science teachers' and the IDs' use of number of instructional elements in their LOs are not meaningfully different ($U=190.00$; $p=0.317$); (d) The preservice science teachers used meaningfully less number of screen orientations in their LOs than the IDs (U=60.00; p=0.000); (e) The quality of LOs developed by the participants were rated by using the LORI and compared using the Mann-Whitney U test (Table 2). As the rating of LOs was carried out for the nine individual items of the LORI as well as LO overall rating, the statistical test was conducted for all of them. The preservice science teachers included meaningfully less features of Feedback and Adaptation in their LOs than the IDs (U=120.50; p=0.031). The quality of the groups' LOs did neither differ in the use of other properties nor in overall quality that LORI measures; (f) Although the groups did not differ in most of the LORI items, whether the preservice science teachers as well as the IDs found the LO development platform usable, the usability questionnaire data was examined. The result indicates that the groups' average perception of the BU-LeCoMaS facilities was positive in general: The current state of the most facilities was confirmed. However, the preservice science teachers found the BU-LeCoMaS facilities more usable than the IDs did (U=112.50; p=0.018).

## *Students' Evaluation of the Developed Learning Objects*

Studies carried out with actual users of LOs, students, may provide data about the effects of LOs on student achievement in the relevant content area. Kay and Knaack (2005) stressed that a set of pre and post-test content questions is important to assess whether any learning actually occurred. Hence, to investigate effect of the LOs in K-12 science with the targeted students in real classroom environments, all forty LOs were ordered according to their overall LORI scores and the LOs received an overall rating of 30 and over were selected: As the maximum overall rating score of LORI for a LO is 45, two-third of the top score was defined as a threshold score. There were eight LOs received an overall LORI rating between 30 and 36. The first three LOs given in Table 1 were developed by the preservice science teachers and the other five LOs were developed by the IDs. The selected LOs were then taken to classrooms where students of the target grades studied them in a lesson hour.

**Table 1: Statistics on the students' evaluation of selected learning objects**

| LO Subject | Grade /age | Sample size | Pre-Posttest item # | Pretest mean | Pretest St.Dev. | Posttest mean | Posttest St.Dev. | Paired t | df | Sig. (2 tailed) * |
|---|---|---|---|---|---|---|---|---|---|---|
| Mirrors | 4/11 | 20 | 10 | 3.20 | 1.936 | 5.10 | 1.447 | 6.371 | 19 | 0.000 |
| Color formation | 4/11 | 20 | 10 | 2.80 | 0.833 | 4.53 | 1.375 | 4.989 | 19 | 0.000 |
| Atoms | 7/14 | 18 | 10 | 5.77 | 2.414 | 7.27 | 2.539 | 3.319 | 17 | 0.004 |
| Motion | 7/14 | 17 | 10 | 4.82 | 1.976 | 5.76 | 1.348 | 2.791 | 16 | 0.013 |
| Electric Circuits | 8/15 | 18 | 10 | 3.44 | 1.099 | 6.22 | 1.003 | 8.444 | 17 | 0.000 |
| Solubility | 9/16 | 24 | 10 | 3.00 | 1.685 | 4.67 | 1.351 | 4.097 | 23 | 0.000 |
| H. Projectile Motion | 9/16 | 47 | 10 | 3.32 | 1.353 | 2.74 | 1.276 | 2.230 | 46 | 0.031 |
| Frictional force | 9/16 | 16 | 10 | 4.00 | 1.549 | 4.88 | 1.996 | 2.573 | 15 | 0.021 |

*$p<0.05$;

The samples of the evaluation studies (Table 1) were obtained from five different local schools where the preservicers do their training. Both before and after the students' work with the LOs, a pretest and post-test were administered. The answers to the tests were scored and analyzed. In all eight applications, the data was normally distributed; hence, Paired-Sample t tests were conducted to compare the pre and the post tests data. The analysis revealed that while seven of the LOs helped the sample students improve their pretest scores in the learning tasks of the LOs, only one of the LOs did not assist the students to improve their pretest scores, instead that LO about Horizontal Projectile Motion (HRM) for ninth grade lowered the students' pretest scores.

# Discussions and Conclusions

In the design of K-12 science LOs, according to the data analysis, (1) the preservice science teachers embedded less number of assets (picture, animation, simulation, sound file, hyperlink, game, video, downloadable-file) and less number of screen orientations (sub-topics –Sharable Content Object (SCO)-, templates, picture orientation, font types and font sizes, colors, main topics) in their LOs than the IDs did; (2) the preservice science teachers authored more amount of text in their LOs than the IDs; (3) the preservice science teachers developed similar number of instructional elements (advance organizers, questions and didactical directions) in their LOs as the IDs did. The preservicers may have embedded more text and less assets and screen orientation in their LOs, perhaps, due to the fact that the preservicers want to explain concepts and procedures directly with text and support it through other representations with screen objects.

The overall quality of LOs the groups developed was similar; the quality of the preservicers' LOs differed only in the feedback and adaptation item from the IDs' LOs. The reviewers' rating of the LOs developed by the preservicers demonstrated that the preservicers are able to develop LOs in "moderate" quality. The LOs are in "tutorial" mode and most participants sequenced a few SCOs to form a LO. The contents are mostly presented in a didactic manner and student-centered activities are not very common in the LOs. Analyses of the developed LOs showed that participants seemed to prefer to use granular resources that agree with findings of a study by Recker et al (2005). Thus, participants seemed to be creating simple projects with somewhat directed activities. Comparisons of the preservicers and the instructional designers' LOs on the basis of reviewers' rating through LORI 1.5 reveal that the groups' LOs did not differ in overall ratings (except for LORI item 3, the groups did not differ at eight individual items of LORI). The quality of the preservice science teachers' LOs are similar to the quality of the IDs' LOs. The IDs seem to represent concepts and procedures with screen objects other than the text and used the text for supporting graphical objects. Both groups developed LOs similar in quality measured with the LORI 1.5. The presentation will share these findings and discuss ways of improving and extending the study.

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