

Development of Learning Objects to Supplement Teaching and Learning

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Abstract

Learning objects are any digital resource used to support learning. To enhance student's understanding in Algebra topics like Exponentiation, Radicals, Special Products, and Factoring were developed as learning objects. The learning objects were developed through the use of Microsoft Office Power Point. It contained the lessons, self-assessment questions, and the evaluation slides. Learning objects were evaluated by selected secondary schools in the Philippines in terms of the following criteria: a) the clarity and organization, b) the student's learning, and c) the design and operability. Based on the student's evaluation, learning objects could serve as effective supplementary materials. Since learning objects are also reusable these could be used to bridge the deficiency of some students in selected areas in Mathematics.

Keywords: e-learning, learning object, supplement

1. Introduction

Mathematics is considered to be a really difficult subject which requires thorough understanding and analysis. It

contains several complex topics which are really hard not only for students to learn, but also for teachers to teach. Interest for this subject can be considered as a rare occurrence.

With these, educational institutions have sought ways to improve their curriculums and incorporate different teaching strategies to improve the teaching-learning process of Mathematics. Hence, with the pursuit of improvement also comes the use of available resources which include technological advancements specifically, computer-aided learning.

A good example of computer-aided learning is the use of computer-based learning objects. Learning objects are instructional materials that are developed in a certain platform and are designed as chunks of information that can be reused or can be transported to form a bigger aggregate learning object.

Learning objects are also digital in nature. It can be delivered or accessed over the Internet or across a network. It can provide assessment to the user's performance. It encourages the user to study independently and thus, offering a more

convenient way of learning. A person can learn at a pace comfortable to him in an enjoyable and interactive manner.

Learning objects can be used in several ways; these can be incorporated as part of a lecture, given as a class activity, or given as a remedial instruction. The later is the most common reason for creating the learning objects.

Special products, factoring, rational exponents, and radicals are some topics in Algebra discussed in the secondary and tertiary level. These topics are the basic foundations of Algebra which often are very hard for students to understand. Hence, development of interactive learning objects

students understand the concepts more clearly and subsequent topics such as rational expressions and solving equations could be grasped more easier.

2. Construction and Development of Learning Objects (LO)

Several learning objects were constructed for rational exponents and radicals, and for special products and factoring. These learning objects were created based on their reusability, inter-operability, flexibility and durability. Reusability is the assembly and re-assembly of the learning object. Inter-operability is the ability of the learning system to work well

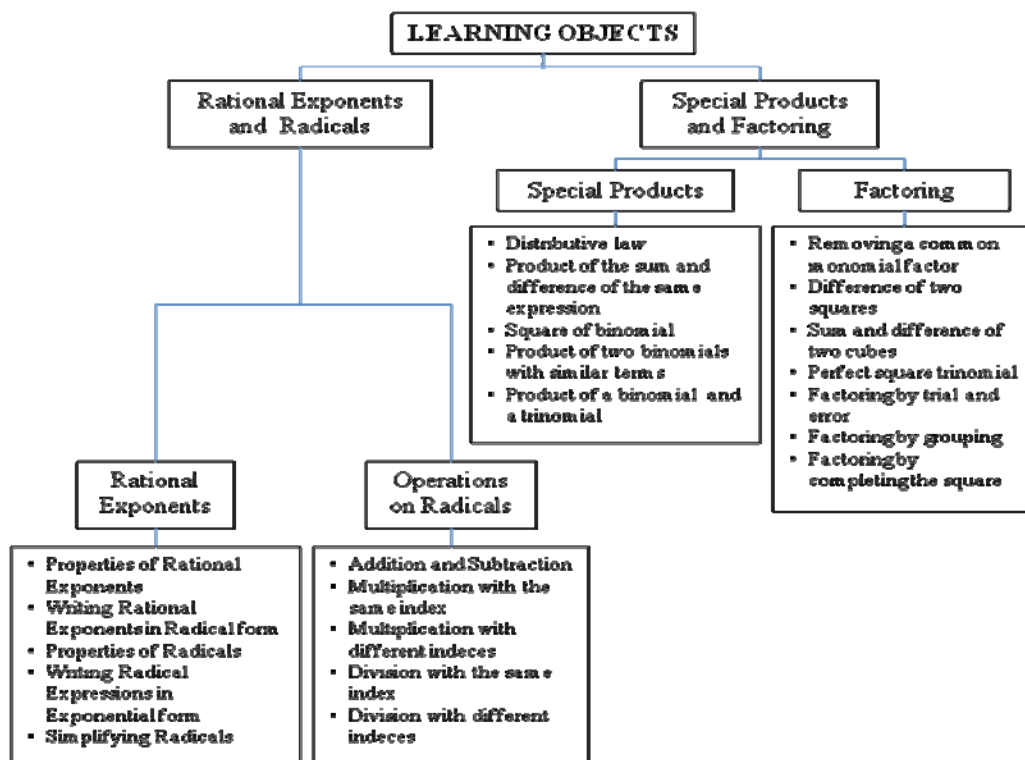


Figure 1. Structural framework of the learning objects.

maybe helpful to aid efficient and fast learning of these topics. These may help

regardless of the developer. Flexibility is designed to be used in multiple contexts.

Durability is the property of LO that remain usable despite changes in delivery and presentation technologies.

The LO was developed using the application Microsoft Office PowerPoint. Design Templates were made. Buttons, animations, pictures, and sounds were also added to be more attractive and interactive. Transition and evaluation frames were also included. The LO was then tested and edited to ensure it was working properly.

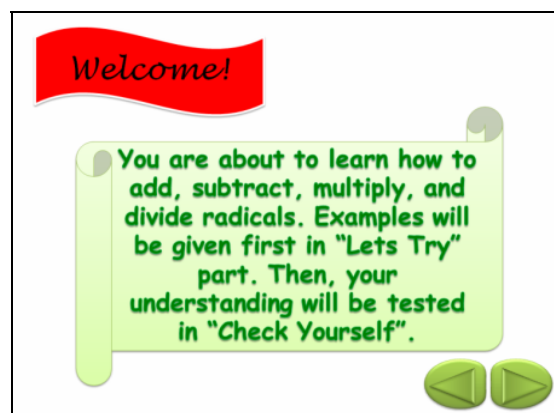
2.1 Features of LO

These learning objects started of with the objectives to inform the users of what they have to attain. Afterwards, the Menu page showed all the topics and each topic was linked to the page where the main discussion starts by the action of the “hyperlink” – a feature of MS PowerPoint. This same feature was also used to link the buttons to their designated pages. The buttons were used to aid in easy operability and in navigating through the learning materials. These buttons were a) “NEXT” button, which allows the users to go to the next page; b) “BACK” button, which allows to go back to the previous page; c) “HOME” button, which allows to shift back to the menu; and lastly, d) “SOLUTION” button, which allows to view the solution for the question.





Each learning object was made up of three parts: the lecture, the examples, and the practice exercises. The lecture contained the definitions, the laws or the properties. The examples were then given to understand more clearly the process, after which, the practice exercises were provided to check the




understanding of the user. But before the practice exercises, a transition slide was viewed to prepare the user for the self-evaluation since s/he can still go back to the previous pages if s/he is not ready yet.

In the practice exercises, at least three questions were prepared for each concept. After every question, the learner could view the solution for the question by clicking the “SOLUTION” button or could go directly to the next slide by clicking the “NEXT” button. Then, the next slide, a transition slide, asked the user how many times s/he tried to get the correct answer thereby evaluating the user’s performance. Transition slides, in general, were used to connect the topics. See sample slides below.



You are also about to encounter the following buttons:




-  **Back** - clicking this allows you go to the previous page
-  **Next** - clicking this will let you go to the next page
-  **Home** - clicking this will let you go to the main menu
-  **Solution** - clicking this will let you see the solution for the question in Check Yourself

Enjoy learning!   

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MULTIPLICATION of RADICALS with DIFFERENT INDICES

If the radicals have different indices, they must be first converted to radicals with the same index before multiplication is performed. The final answer must be expressed in simplest form.



  

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Objectives

At the end of this module, you must be able to:

1. Add and subtract radicals;
2. multiply radicals with the same and different indices; and
3. divide radicals with the same and different indices.

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Let's try!

Write in exponential form.

- 1) $\sqrt[3]{y} = y^{\frac{1}{3}}$
- 2) $\sqrt[7]{n^4} = n^{\frac{4}{7}}$



[Click here to see more examples.](#)

Writing Radical Expressions in Exponential Form ©University of the Philippines Los Baños

OPERATIONS ON RADICALS

- [Addition and Subtraction and Radicals](#)
- [Multiplication of Radicals with the Same Index](#)
- [Multiplication of Radicals with Different Indices](#)
- [Division of Radicals with the Same Index](#)
- [Division of Radicals with Different Indices](#)

[Click on a topic for further discussion.](#)

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It is now your turn! Check your skills by answering the questions in the next slides.



Multiplication of Radicals with the same index ©University of the Philippines Los Baños

CHECK YOURSELF

Apply the properties of rational exponents on the given expressions. Click the best answer among the given choices.

1.) $(m^4)^{\frac{1}{5}} = \underline{\hspace{2cm}}$

a) $m^{\frac{1}{20}}$

b) $\frac{1}{m^{\frac{1}{20}}}$ **CORRECT!**

c) $\frac{1}{m^{20}}$

Properties of Rational Exponents ©University of the Philippines Los Baños

You are now finished with multiplication of radicals with different indices. It is now time for you to learn how to divide radicals.

Multiplication of Radicals with different indices ©University of the Philippines Los Baños

Check it out!

3.) $\frac{\sqrt[3]{\sqrt[4]{27y^7}}}{\sqrt[4]{\sqrt[3]{9y^5}}} = \sqrt[12]{3y^2}$

Solution

$$\frac{\sqrt[3]{\sqrt[4]{27y^7}}}{\sqrt[4]{\sqrt[3]{9y^5}}} = \frac{\sqrt[12]{27y^7}}{\sqrt[12]{9y^5}} = \sqrt[12]{\frac{27y^7}{9y^5}} = \sqrt[12]{\frac{27}{9}y^{7-5}} = \sqrt[12]{3y^2}$$

Properties of Radicals ©University of the Philippines Los Baños

How many times did you try to get the correct answer? Click the number.

Writing Expressions with Rational Exponents in Radical Form ©University of the Philippines Los Baños

2.2. Evaluation of the Learning Objects

Field testing of the LO was done. Two schools for each LO were requested to be the evaluators. 31 senior students from Maquiling School, Inc. (MSI) and 25 senior students from Muntinlupa Business High School (MBHS) evaluated the LO for the rational exponents and radicals. On the other hand, 28 sophomore students from Christian School International (CSI) and 28 senior students from MSI assessed the LO for special products and factoring. All students were asked to view the developed LO. Then, an evaluation form was provided to determine their feedback.

The criteria used for the evaluation of the learning objects were divided into three clusters: clarity and organization, student learning, and design and operability (see Table 1). The Clarity and Organization cluster determines if the developed learning object was clear and organized, and the topics were comprehensible. The Student Learning cluster determines if the developed learning object promoted learning of the student/user. Lastly, the Design and Operability cluster determines if the

templates and designs used in the learning object enhanced the learning process and if the learning objects were easy to use. It also contributed to the fun side of learning since it made the LO interactive. Therefore, these three clusters were important to evaluate and to determine the effectiveness of the developed learning object.

In the evaluation, the students' responses in each criterion were tallied. Each response was given a numerical value depending on the response. Agree was given a value of 1, slightly agree was 2, neither agree nor disagree was 3, and slightly disagree and disagree were given 4 and 5, respectively. The recorded frequencies were then used to compute for the weighted average values. To get the overall picture in each cluster, the mean of the weighed average was also computed.

Table 1. Statements used for the evaluation of the learning objects based on the three clusters

CRITERIA	
A. Clarity and Organization	<ol style="list-style-type: none"> 1. The objectives are clearly stated. 2. All topics are explained clearly. 3. The learning objects completely covered all items in the objectives. 4. The subtopics are organized.
B. Student Learning	<ol style="list-style-type: none"> 1. All examples are enough for learning. 2. All examples are easy to understand. 3. Exercises promote deeper understanding of each topic. 4. The Student can learn the topic in his/her own pace. 5. The student can check how well s/he performed.
C. Design and Operability	<ol style="list-style-type: none"> 1. The learning object is user-friendly. 2. It is appealing to the eyes. 3. It can hold enthusiasm throughout. 4. It is easy to use.

3. Results and Discussion

Evaluation of the LO for Rational Exponents and Radicals. A total of 56 Fourth year students were requested to view and to give their evaluation of the learning object. Respondents were 31 students from IV-Magalang of Maquiling School, Inc. (MSI) and 25 students from IV-Gold of Muntinlupa Business High School (MBHS).

Based on Table 2, results showed that both MSI and MBHS gave favorable responses under each cluster of the criteria since all the computed average values fell between one and two which then corresponded to the agree and slightly agree responses, respectively. It can also be noted that the mean responses of MSI in each cluster had higher weighted average on all clusters compared to that of MBHS. This means that MSI slightly agreed in each criteria. The reason could be that MBHS students are more homogeneous while MSI is not. This means that mostly of the students are above average since sectioning in MBHS was based on the previous year's grade. Students in these section(Gold) are the top students in the graduating class.

Table 2. Mean of the weighted average of the students' responses on the three clusters of the learning object for rational exponents and radicals

CLUSTER	MSI	MBHS
CLARITY AND ORGANIZATION	1.61	1.21
STUDENT LEARNING	1.94	1.29
DESIGN and OPERABILITY	1.70	1.21

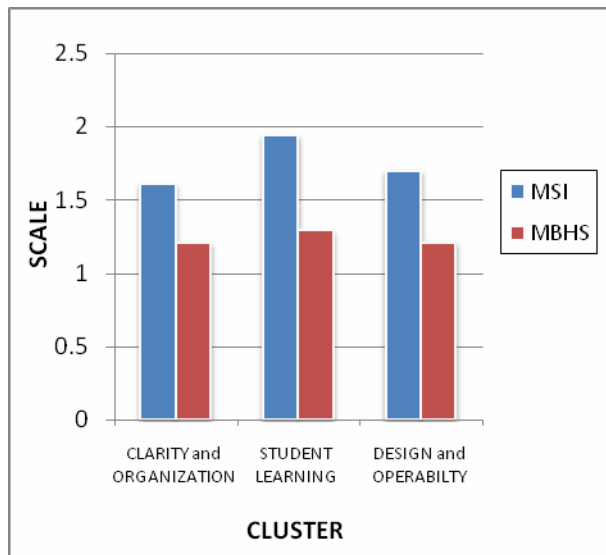


Figure 2. The mean of the weighted average of the students' response from MSI and MBHS on the three clusters of the learning object for rational exponents and radicals.

Figure 2, showed a more obvious discrepancies in the responses of these two schools.

3.1 Evaluation of the LO for Special Products and Factoring.

Twenty-eight sophomore students from Christian School International (CSI) and 28

senior students from Maquiling School, Inc (MSI) evaluated the LO. After the hands-on of the learning objects, they were asked to fill up an evaluation form.

Table 3 reflects that MSI had lower average on clarity and organization, and student learning than that of CSI. This means that students of MSI agreed on the idea that the learning objects developed were clear, organized and workable. However, CSI and MSI had an almost equal average on design and operability with close values of 1.54 and 1.59, respectively. This could be accounted by the fact that students are already familiar with the use of Power Point presentations and they were appreciative of the manipulative techniques of learning.

Furthermore, note that on the criteria under student learning, both schools gave a slightly agreed respond. The reason for this was the difficulty of understanding the topics especially factoring which is common experience even in class room situation. Note that these topics are discuss in the second year(second quarter) in both schools yet CSI mean weighted average is higher than MSI.

Over all, as shown in Figure 3, the average values obtained from the two schools in any clusters were nearly close to each other even they were of different year level.

Table 3. Mean of the weighted average of the students' responses on the three clusters of the learning object for special products and factoring.

CLUSTER	CSI	MSI
CLARITY AND ORGANIZATION	1.53	1.40
STUDENT LEARNING	1.71	1.69
DESIGN and OPERABILTY	1.54	1.59

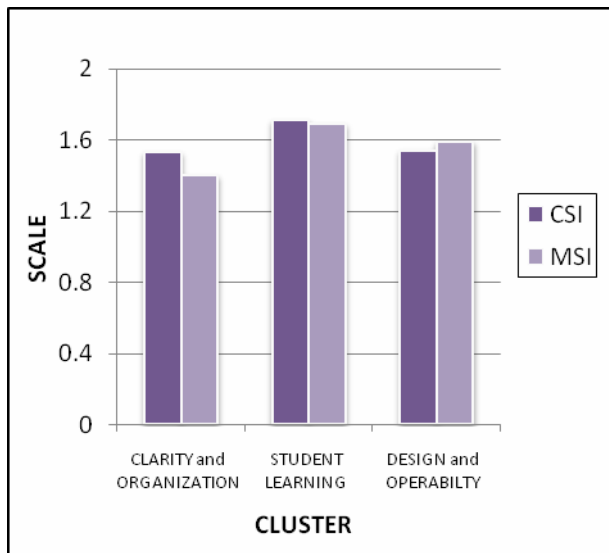


Figure 3. The mean of the weighted average of the students' response from CSI and MSI on the three clusters of the learning object for special products and factoring.

4. Conclusion

Development of learning objects or any interactive materials is now a common trend in any educational institutions. Most of this learning objects are developed using

software such as macromedia flash that multimedia expert or programmer can understand the language. Only few may realize that Power Point has the capability of producing LO. Since students are more familiar with it, they can be tapped to develop LO and has a great possibility of enhancing their creativity.

Results from Maquiling School, Inc, and Christian School International with diverse type of students showed a positive respond to the LO developed. On the other hand, students of Muntinlupa Business High School gave a more affirmative evaluation. This only means that these students support the idea that learning objects can be an effective supplementary materials.

Hence, with the availability of learning objects especially in mathematics, these can be a way to teach and remediate students specially those who need a refresher in some topics in Algebra.

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