

Designing Learning Objects for Teaching and Learning Mathematics for Students in Secondary School

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1) Introduction

In the teaching and learning of mathematics for students in secondary schools, it has been found that geometry transformation is one of the concepts that learners find hardest to understand, and has been added to the Basic National Education Curriculum 2001. The media currently used in the teaching and learning of mathematics are mostly in the form of textbooks or handouts which are limited in their visual presentation of the concepts of translation, light reflection and rotation. (The Basic National Education Curriculum, 2001, 2002 and Nomsri Kate, 1992, pp. 55)

Learning objects are the new digital media supported by multimedia technology that makes use of still pictures, 3-D pictures, moving objects, texts and sounds in the presentation of information. The focus is on learners' participation in entertaining learning activities in the form of simulations, games or experiments. These activities aim at creating enthusiasm and enjoyment while learners take part in activities that promote learning through the use of media (Atkins & Jones, 2004). This corresponds with Thanomporn Laohajatsang (2007, pps. 51-52) defining a learning object as a learning module in a digital format which is self-contained. Each module comprises objectives and content that present one or more integrated concept, with interactive exercises and/or tests to assess the learners' learning results. Learning objects focus on simulation, games, and/or exploration and discovery that are conducive to meaningful learning.

For this reason, it is our belief that if learning objects are used as learning visual aids

for the teaching-learning of geometry transformation, learners will be able to better understand the content and practice their mathematical skills through their participation in learning object activities. This is because such media employs multimedia technology that uses still pictures, 3-D pictures, moving objects, texts and sounds in the presentation of information. This will enable learners to visualize and analyze the process in creating the pictures more easily. (Atkin, 2005)

2) Objectives of the Study

To design quality geometry transformation learning objects for the teaching-learning of mathematics for students in secondary school.

3) Scope of the Study

This study focuses on the design of learning objects for the teaching-learning of mathematics, with emphasis on the study of learning object quality in terms of the teaching-learning design, screen and multimedia design, and learning object media application. However, this study did not focus on the effect of integrating learning object media in relation to the scores of learners in class assessments.

4) Concepts Related to Learning objects

4.1) Special Features of Learning Objects

Thanomporn Laohajatsang (2007, pps. 52-53) described the 6 features of learning objects as: 1. Reusability, 2. Sharability, 3. Interoperability, 4. Bite-sized/Granularity, 5. Self-containment, and 6. Conduciveness to

learning. This study will focus merely features 4-6. (For the details of each feature, please study the referenced paper.)

4.2) Importance of Learning Object Design

In designing learning objects, emphasis should be placed on designs that are conducive to meaningful learning rather than designs that aim merely at presentation of objects. Designs should be in the form of games, simulations, exploration and discovery as these are the formats that best promote meaningful learning. These types of design also encourage active learning on the learners' part and support the "Learning is Fun" concept. With this method of learning, learners are assigned activities such as problem-solving in the simulated roles and situations, thus making the learning experience both entertaining and educational. (Thanomporn Laohajaratsang, 2007)

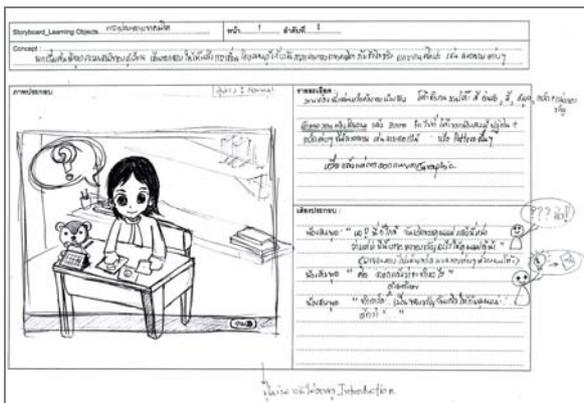


Figure 1: A Sample of Designing Learning Object

5) Research Procedures

5.1) Sample Group

The sample group of this study consisted of 43 students in Mattayom 2 of Chiang Mai University Demonstration School in their first semester, academic year 2008.

5.2) Research and Data Collection Instruments

The research instruments used were the geometry transformation learning objects designed in the form of games. Learners were to work on activities to look for methods to

create pictures that would appear as a result of geometry transformation.

The instruments used in data collection were the questionnaires on the use of geometry transformation learning objects covering the following areas: screen and multimedia design, teaching-learning design, content design, and learning object application.

6) The instructional design of geometry transformation learning objects consists of 4 stages:

6.1) Preparation Stage

To study the content of geometry transformation and research learning object media designing.

6.2) Design Stage

To analyze the content to set main topics and types of learning object activities, create storyboards, and have content experts and media design experts check the storyboards.

6.3) Development Stage

To construct learning objects as specified in the storyboards, have content experts and media design experts check it before modifications are made as suggested.

6.4) Modification Stage

To test the learning objects on the sample group to collect data in terms of media quality, analyze the results and draw conclusions. The data is presented in the form of tables as well as a written report. Finally, the learning object users' handbook is prepared.



Figure 2: Samples of Screens from Learning Objects on Geometry Transformation

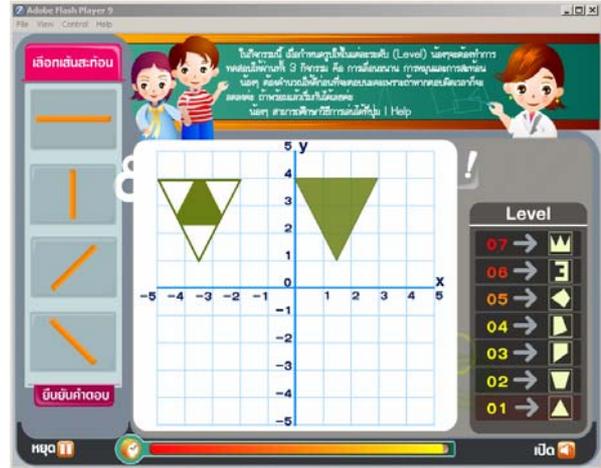


Figure 5: Samples of Screens from Learning Objects on Geometry Transformation



Figure 3: Samples of Screens from Learning Objects on Geometry Transformation

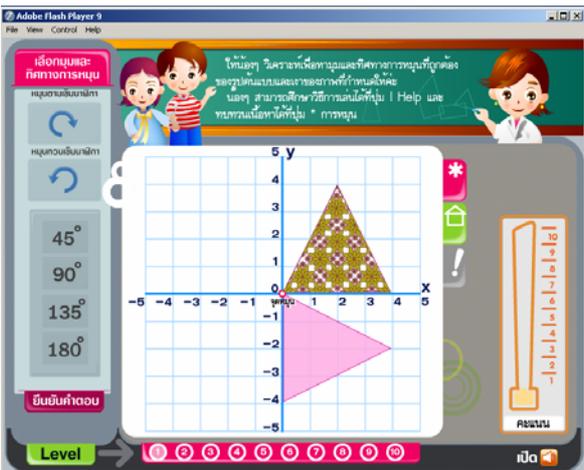


Figure 4: Samples of Screens from Learning Objects on Geometry Transformation

7) Data Collection

The data collection for this study employed the following steps: 1. Introduce the steps of learning object application; 2. Explain the questionnaires to be used after the trial use; 3. Let the learners try out the learning objects using 1 computer/1 learner; 4. After the learners have finished trying out the learning objects, they are required to fill out the learning object application questionnaires.

8) Statistics and Data Analysis

The data collected in this study was analyzed using basic statistical values namely Mean (\bar{x}) and standard deviation (S.D.) and presented in the form of tables and a written report.

9) Research Results and Discussion

The study and test of the learning objects found that in terms of the teaching-learning and content design, most learners strongly agreed that the introduction of moving and graphic pictures as part of the learning objects was seen as aiding the learning. Furthermore, the format of activities and their presentation of concepts through the learning objects' graphics and moving pictures helped them to visualize and understand the reflection and rotation concepts more easily. Also, the learners had control and a chance to take part in activities using learning objects, which correlates with Haughey & Muirhead (2005, pps. 1-6) which stated that a learning object design that attracts learners'

attention and stimulates learners is often in the form of simulation, games, act of discovery like in a scientific process, or investigation based on given situations. It is designed by integrating multimedia in interactive activities which enable learners to have control of their own learning through tackling learning object activities.

Regarding the screen and multimedia design, most learners strongly agreed that the colors and font sizes used in the learning object design were clear and easy to read. The learning objects were constructed following the principles of electronic learning media design which state that a good screen design should above all take into consideration the readability for learners, so the emphasis was on contrast of font and background colors such as a black font on a white background. The font size was chosen to suit the age and learning style of learners. (Thanomporn Laohajatsang, 2002) In addition, the researcher also followed the learning object design concepts of Atkins & Jones (2004, pps. 16-20) which state that the application of graphic and moving pictures in a design not only attracts learners' attention, but also helps present abstract concepts in a concrete form so as to make learners understand more easily.

As for the application of learning object media, most learners strongly agreed that learning through learning object media in the form of games was entertaining and helped enforce their geometry skills. This corresponds with the study done by Clarke & Gronn (2004) which stated that the application of learning objects in the teaching and learning of mathematics helped the learners to understand the subject matter more clearly through novel presentation; making the learning of mathematics interesting and fun as well as easier to understand. The learning object multimedia helps attract the learners' attention through games and allows them to take control of their learning according to their individual ability. This corresponds to Thanomporn Laohajatsang (2007, pps. 55-58) which stated that the design media in the form of learning objects must be conducive to meaningful learning rather than a mere presentation of objects. Designs should be in the form of

games, simulation, discovery and exploration as these are considered conducive to meaningful learning. They also support the concept of active learning.

In addition, the learners also made some recommendations regarding the creation of learning objects. They felt that the learning objects created and usability-tested were interesting and new, and that more learning objects should be developed for other mathematical topics such as factorization, surface area and volume calculation, etc. Also, more activities and more diverse levels of difficulty of learning objects should be developed such as problem solving type questions. From the mathematics teachers' interviews, suggestions were made regarding more diverse types of supplementary activities such as the creation of simulating learning objects that require learners to apply their knowledge of mathematics to solve mathematical problems as well as everyday problems they may face in the real world.

10) Recommendations

1) More diverse learning objects should be developed so that learners can practice their skills. For example, situations or mathematical problems that are set for the students to practice their mathematical problem-solving skills, or scientific experiment activities which are designed for them to practice their scientific skills, etc.

2) More learning objects should be created to cover other mathematical topics such as a calculation of area size, percentage and data collection, etc.

11) References

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