‘Surala Ninja!’: a mathematics e-learning based on Learning Management System as an alternative learning in elementary school

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Abstract. e-learning based on Learning Management System (LMS) has contributed a lot to the education system. e-Learning based on LMS includes learning management, student management, evaluation management components, online practice, online material content, online assessment. ‘Surala Ninja!’ is a mathematics e-learning for elementary level. It will examine how ‘Surala Ninja!’ e-learning meets LMS components and how ‘Surala Ninja!’! LMS improves numeracy skills, trains mathematical thinking, embed learning characters, and compares it with the 2013 school curriculum. The results show that although ‘Surala Ninja!’ content and the low-level curriculum is sliced mainly, but ‘Surala Ninja!’ contains a lot of reinforcement and deepening of materials that not provided in school, so that LMS-based e-learning is an alternative for individual learning.

1. Introduction

e-Learning is a learning system which is learner-centered and giving the students opportunity to learn thoroughly about a specific topic, those are e-Learning definition according to Ashraf in [1]. Felder and Silverman in [2] stated that learning styles are depend on the learner’s taste. Aral and Zehra in [3] conduct research on elementary and middle school students by dividing learning styles into two categories, namely traditional learning styles and learning styles using e-learning. The results of their research show that both are adequate both theoretically and empirically.

The researchers defined the effectiveness of e-learning from a variety of perspectives. Noesgard in [4] found 19 different definitions of effectiveness, and the most common way of measuring effectiveness was based on pre and post test. Birzina in [5] states that the use of technology, information, and communication in learning will be effective if it involves students' personal experiences, feelings of self and social recognition. Ashraff, who studies e-learning at the secondary and tertiary level, stated that e-learning is more effective for Mathematics, Science and English.

Queiros & Leal in [6] conducted a study of standardizing e-learning content, and combining information in most standards and categories that emerged based on three aspects: metadata, content presentation, and learning design. Creation, administration and access to online content are combined and sorted using Content Management Systems (CMS). Content development must pay attention to Learning Object (LO).
Felder and Silverman [7] revealed that learning styles depend on learners' preferences. Aral & Zehra in [8] conducted research on elementary and middle school students by dividing learning styles into two categories, namely traditional learning styles and learning styles using e-learning. The results of the study show that both mathematics learning in the usual style and the e-learning style, both are adequate both theoretically and empirically.

E-learning based Learning Management System (LMS) has contributed a lot to the education system. Patel in [9] reveals that most of LMS-based e-learning includes course management, student management, feedback management, online examination, online course material, and online assessment.

SuRaLa Net.co.co developed an LMS-based e-learning mathematics for elementary level called ‘e-Learning ‘Surala Ninja!’’, [10]. The e-learning uses the OGO Method, developed by Masaru OGO, which emphasizes composition and decomposition.

In this paper we will examine the characteristics of ‘Surala Ninja!’ as LMS, ‘Surala Ninja!’ material content in instilling mathematical mindset and its relation to school curriculum, and implementation portrait of ‘Surala Ninja!’.

2. Methods

2.1. E-Learning Berbasis LMS

Patel in [9] describes traditional LMS-based e-learning in Figure. 1.

![Figure 1. Traditional e-learning based on LMS](image)

Course management facilitates the addition, management, and improvement of materials, and assignments from the teachers. Student management facilitates enrollment of students and their choice of topics. Online examination is a module to evaluate students automatically which is stored within a certain period of time. Online assessment is a facility for students to collect their assignments online. Online course material facilitate the teachers to teach online. In feedback management students could obtain a personal feedback as a result of the assessment of the task or test.

2.2. Mathematical Thinking

Stacey in [2] explained about mathematical thinking. She thinks that mathematical thinking is a process that contains making conjectures, concluding, finding patterns, proving, composing, decomposing, and so on. Subanji [11] stated that mathematical thinking is different with empirical thinking that can be faced in science. Mathematical thinking is a deductive thinking which contain a reasoning. Devlin [12] said that mathematical process are identifies and analyzes abstract patterns (numerical patterns, patterns of shape, patterns of motion, patterns of behavior, voting patterns in a population, and so on). Based on
those preferences, it can be concluded that mathematical thinking is a process that involves reasoning, making conjecture, finding pattern, proving, and analyzing. We later show that ‘Surala Ninja!’ trains student to develop their mathematical thinking.

2.3. School Curriculum
Elementary Schools use a thematic curriculum, and the scope of elementary mathematics based on [3] are:

- Numbers: count numbers, integers, primes, fractions, multiples and factors, ranks and roots.
- Geometry and measurement: plane field and volumes, the relationship between lines, weight, length, area, volume, angle, time, velocity, debit, location, and coordinates of an object.
- Statistics: present and interpret a single data.

2.4. e-Learning Matematika ‘Surala Ninja’
SuRaLa Net.co mengembangkan e-learning matematika berbasis LMS untuk tingkat sekolah dasar, yaitu ‘e-Learning ‘Surala Ninja!’’, [10]. Learning using OGO Method developed by Masaru OGO, which is a method of learning mathematics that focuses on composition and decomposition. Surala Ninja focuses on mastering the basic operations: addition, subtraction, multiplication, division, and combining operation of natural numbers.

3. Result and Discussion
SuRaLa Net.co developed LMS-based e-learning math for elementary school level, namely ‘Surala Ninja! e-Learning’, [10]. Learning using OGO Method developed by Masaru OGO, which is a method of learning mathematics that focuses on composition and decomposition. ‘Surala Ninja!’ focuses on mastering the basic operations: addition, subtraction, multiplication, division, and combining operation of natural numbers.

3.1. Learning Management System ‘Surala Ninja’
As we have mentioned in section 2 that Patel proposes five components in the LMS. In this section will be shown how the implementation of the five components in ‘Surala Ninja’.

3.1.1. Course Management ‘Surala Ninja!’ divides the course into 11 levels, Level 1-3 on addition, Level 4-6 on subtraction, Level 7 & 8 on multiplication, Level 9 & 10 on distribution, and Level 11 on mixed arithmethics. Each level is divided into several lessons, and each lesson consists of several units. For example in Figure 1a is a material of Level 1 (addition) - Lesson 2 (Compilation and parsing of numbers) consisting of 12 units, the details are in Table 1.

| Table 1. Level 1 Lesson 2 Indicator. |
|--------------------------------------|
| **Unit Number** | **Unit** | **Indicator** | **Number of sub unit problem** |
|-----------------|----------|---------------|-----------------------------|
| 1               | Composition using numbers and objects | Be able to compose numbers 1 up to 10 with numbers and objects | 9 |
| 2               | Decomposition using numbers and objects | Be able to decompose numbers 1 up to 10 with numbers and objects | 9 |
| 3               | Composition dan decompoition using numbers and objects | Be able to compose and decompose numbers 1 up to 10 with numbers and objects | 6 |
| 4               | How to make number 5                  | Understand how to separate number 5 without using objects or images; shows how to separate number 5 by mathematical equations | 11 |
| 5               | How to make number 6                  | Able to understand how to separate number 6 without using objects or images; shows how to separate number 6 by mathematical equations | 11 |
| Unit Number | Unit                        | Indicator                                                                                           | Number of sub unit problem |
|-------------|-----------------------------|-----------------------------------------------------------------------------------------------------|----------------------------|
| 6           | How to make number 7        | Able to understand how to separate number 7 without using objects or images; shows how to separate number 7 by mathematical equations | 11                         |
| 7           | How to make number 8        | Able to understand how to separate number 8 without using objects or images; shows how to separate number 8 by mathematical equations | 11                         |
| 8           | How to make number 9        | Able to understand how to separate number 9 without using objects or images; shows how to separate number 9 by mathematical equations | 11                         |
| 9           | How to make number 10       | Able to understand how to separate number 10 without using objects or images; shows how to separate number 10 by mathematical equations | 11                         |
| 10          | How to make number 2 and 3  | Able to create numbers 2 and 3 without objects or images; shows how to separate say 2 and 3 by mathematical equations; understand how to separate number 4 without using objects or images; shows how to sort numbers through mathematical equations | 9                          |
| 11          | Number recipe of 25 patterns (1) | Able to memorize how to separate numbers 2 to 10                                                 | 9                          |
| 12          | Number recipe of 25 patterns (2) | Able to memorize how to separate numbers 2 to 10                                                 | 9                          |

Number of unit problem 117

The detailed and complete structures of level-lesson-unit arrangement makes it easier for teachers to: design learning tailored to the individual student's abilities, select the essential units that each student should study and select the exercise questions to be done according to the individual student's condition (it is possible to jump or repeat the exercise sub-unit).

3.1.2. **Student Management** Prospective students will have access to ‘Surala Ninja!’ after registration and admin will create the account (user ID & password). Furthermore, students can access LMS ‘Surala Ninja!’ by using the account, learn the courses (learning contain) and doing the exercises.

3.1.3. **Online Examination** Examination is given within each unit of the lesson. Students can see right or wrong of any number of questions that are done directly. The value of each training unit will be kept and documented properly as long as the admin does not reset the account.

3.1.4. **Online Assessment** Assessment is done online, the result of student's work can be seen by the teacher to be observed if there is part that need to be repeated or continued. Therefore, students can be declared passed and level up.

3.1.5. **Online Course Material** Learning materials of addition, subtraction, multiplication, division, and combining operation for the elementary level presented online in a step by step and structured that is expected to develop student’s mathematical mindset, Fig 1.

3.1.6. **Feedback Management** Students get feedback in the form of grades and medals that can be seen by the students at the end of work and exercises (see Figure 1a). If a student made a mistakes, he/she will get a feedback in form of re-explanations (Figure 1b). Students will also be shown the correct or false answers during the test (Figure 1d).
Figure 2. Example of ‘Surala Ninja!’.

Figure 2 shows online examination, online assessment, online course material & feedback management integrated in LMS ‘Surala Ninja!’

3.2. Material Content of ‘Surala Ninja!’

As previously stated, ‘Surala Ninja!’’s content computation of positive-grade integers including addition (Level 1 - Level 3), subtraction (Level 4 - Level 6), multiplication (Level 7 - Level 8), and division (Level 9 - Level 10), as well as mixed operation (Level 11). When compared with the school curriculum as it appears in the 2.3 section, it is seen that there is a significant gap. However, if we take a closer look at the content of ‘Surala Ninja!’’, there are many advantages in this e-learning. Especially in instilling the mathematical thinking.

Here we will show the development of a mathematical mindset for a Level 1 material that includes Lesson 1 (The number 1 through 10), Lesson 2 (Composition and decomposition of numbers), and Lesson 3 (Addition of numbers). Furthermore, we will focus on Level 1 Lesson 2, the details of the material can be seen in Table 1. Mathematical thinking in ‘Surala Ninja!’ material content is shown in the following Table 2.

From Table 2 it is seen that the material is presented in step by step and very detailed with many units for each subject, this shows that e-learning ‘Surala Ninja!’ is given deeply and trained skills to advanced level. This is supported by Surala's research results in pilot schools 1, Table 3, which serves to improve the ability (speed and accuracy) of student counting. The table also shows that the students with score less than 100 or the processing time was more than 5 minutes, quite significant.
Mathematical thinking dalam ‘Surala Ninja!’

| Mathematical Thinking | Unit Information |
|-----------------------|------------------|
| Synthesize            | 1-1 s/d 1-9: Compose number 1-10 by using objects.  |
|                       | 3-1 s/d 3-6: Compose number 1-10 without using objects.  |
| Analyze               | 2-1 s/d 2-8: Decompose number 1-10 by using objects. |
|                       | 4-1 s/d 9-10: Decompose number 1-10 without using objects. |
| Prove                 | 10-1 s/d 10-9: Mathematical expression to show how to make numbers 1-10 |
| To find the pattern and make a conclusion | 11-1 s/d 12-9: Number recipe of 25 Patterns |

### Table 3. Counting speed of grade V students at pilot school I. (source: Surala)

| 100 counting box | Score | Time | Baseline | Endline | Gain |
|------------------|-------|------|----------|---------|------|
| Addition         |       |      |          |         |      |
|                  | 100   | 0' - 1' 59" | 0,0 | 4,2 |
|                  | 2' - 2' 59" | 0,0 | 14,6 |
|                  | 3' - 3' 59" | 0,0 | 33,3 |
|                  | 4' - 4' 59" | 2,1 | 8,3 |
| <100             | > 5'   | 97,9 | 39,6 | -58,3 |
| Substraction     |       |      |          |         |      |
|                  | 100   | 0' - 1' 59" | 0,0 | 0,0 |
|                  | 2' - 2' 59" | 0,0 | 8,3 |
|                  | 3' - 3' 59" | 0,0 | 22,9 |
|                  | 4' - 4' 59" | 0,0 | 16,7 |
| <100             | > 5'   | 100,0 | 52,1 | -47,9 |

3.3. Portrait of ‘Surala Ninja!’ Implementation

LMS ‘Surala Ninja!’ is currently implemented in some elementary schools in Bandung. The implementation of the learning is done in the school computer laboratory.

The learning is done by habituation as follows: (a) students lined up; (b) taking ‘My agenda’; (c) sitting neatly; (d) entering account ID & password; (e) learning; (f) writing in ‘My agenda’; (g) finish learning & learning; (h) moving the surala meter; (i) tidy up & restore ‘agendaku’; (j) moving class in an orderly manner. Photographs of learning can be seen in Figure 3.

Such habituation instills the discipline characters and independence to the students. ‘My agenda’ is a record of the grade of each unit that appears on the computer. Since the students record their own grades to ‘My agenda’, it is expected that honesties embedded in their character (because if their grades are less than 80, they need to rework the same unit problem). Surala meter is a measure of the number of units that have been done, it motivates students to be more diligent and enthusiastic. Changes in student’s character based on the teacher's assessment questionnaire are shown in Figure 2d.

Other interesting things from the ‘Surala Ninja!’ e-learning methods are: (a) Individual learning, students can learn according to their own ability and speed of learning (student centered); (b) students can enjoy learning with ninja as tutors; (c) small steps learning, namely by increasing the level of difficulty little by little; (d) the speed of working on the problem through ‘My challenge’. 
4. Conclusion
From the above description it can be concluded that: E-learning ‘Surala Ninja!’ meets the criteria of Learning Management System. Although ‘Surala Ninja!’’s material content does not cover all the curriculum materials of the regular school, however, with many units available, it has advantages in practicing aritmethics skills, developing mathematical thinking, and instilling better characters. ‘Surala Ninja!’ e-learning is satisfied for down grade (grade 1, 2, 3 & 4) as individual learning.

According to the advantages in ‘Surala Ninja!’ e-learning, It is suggested to review further: Efficiency and effectiveness of e-learning more thoroughly, Development of LMS for other elementary mathematics materials.

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