Deepening students understanding of triangle topic through ‘application’ component of ELPSA (Experience, Language, Pictorial, Symbol and Application) framework

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Abstract. ELPSA (Experience, Language, Pictorial, Symbol and Application) is a learning framework that was introduced as a sequence of a learning process which presents mathematical ideas through lived experience, mathematical conversation, visual stimuli, symbolic notation and the application of applied knowledge. Employing the “application” component of ELPSA framework in the mathematics classroom emphasizes how the understanding of certain material can be applied to a new situation. This study investigates the learning process during the class activity about the triangle. The study was conducted in one of the junior high school in Central Lombok, West Nusa Tenggara. The data were collected from teaching and learning videos and students’ work during the learning processes in the classroom. We transcribed and analysed the video as well as looked at the students’ works. The result shows that the activity of composing a 2D shape from various types of triangle support students in deepening their understanding about the types of triangles. Also, the activity of composing 2D shape can be a promising foreground for students in their following learning about the area of the composite figure.

1. Introduction

Education agencies and researchers from different countries have been seeing the importance of knowing how to apply the mathematics knowledge that students learn at school not only to assess their understanding of the material delivered in class but also their knowledge on how to apply what they know in the new situation [1,2,3]. For example, Program for International Student Assessment (PISA) 2015 reported that PISA assesses not only the student’s ability to extrapolate what they have learned but also whether students can apply their knowledge in unfamiliar setting both in and out of school. This recent demand in education reflects the fact that modern markets values individuals not only for what they know but also for what they can do with what they know [4].

Application of the subject learned is rarely discussed explicitly in mathematics classroom in Indonesia [5]. Based on the interview with mathematics teachers in Central Lombok, West Nusa Tenggara, they stated that the tasks given were mainly the authentic close-end type of problems based on the lesson learned rather than the open-end type of application-based problems. Despite many possible factors causing Indonesia students having the low performance for mathematics in PISA [6], the less task in the open-ended type of application problems could be one of the causes. Therefore, it is
critical to include more of the application of the lesson learned within the Indonesian mathematics curriculum.

Numbers of learning framework do not include application in the learning process explicitly [2], meanwhile ELPSA (Experience, Language, Pictorial, Symbol and Application) framework explicitly include “A (Application)” component which help students to develop their ability in utilising the existing knowledge to be applied in various situations [7]. This study focusses on the application component of ELPSA as part of the whole series of ELPSA framework implementation at school for the sub-topic types of triangles. The overall lesson plan consists of three sequences with the duration of 1x40 minutes for each sequence. The first and second sequence focused on “ELPS” components and the third sequence focused on “A” component. This study, however, focused only on the third sequence where the focus is on “A” component of ELPSA, as aforementioned that our concern is on the lack of application implementation in Indonesia mathematics classroom.

This present study, therefore, investigated the learning process during the class activity of composing 2D shape from the various types of the triangle on how it helps students deepening their understanding about the types of triangles. The research aim was then stated in the research question: “How does the activity of composing 2D shape from various types of triangle help student in deepening their understanding about the types of triangles”.

2. Methods

2.1 Participants
This qualitative descriptive study involved 24 Year seven students which consist of 12 females and 12 males. During the group-work activity, the students were divided into five groups of 4-5 students. This research conducted in one of the junior high schools in Central Lombok district, West Nusa Tenggara, Indonesia. The school locates in a remote area while the students come from the middle economic family background.

2.2 Data collection and analysis
In order to investigate the research question, the data were collected from teaching and learning videos and students’ work during the learning processes in the classroom. The teaching and learning processes were based on the activities that have been designed. We transcribed and analysed the video as well as looked at the students’ works. The analysis was focused on the students learning process during the group-work activity in composing 2D figure from various types of triangle.

2.3 Lesson design
The sub-topic types of triangle in mathematics lesson related to this study were designed in three lesson plans. The use of ELPSA framework in designing the lesson was very beneficial because it strongly aligns with how mathematics ideas should be sequenced so that student can understand the lesson easier [8]. The first lesson plan focused on ELP components of ELPSA framework. It contained the main activities to mention the characteristics and similarities of triangles by looking at the sides or angles of the triangles. The second lesson plan focused on the LPS component where the main activities were classifying the triangles and make a concept’s map of the types of triangles. On the third lesson plan, we only focused on “A” component through the activity of composing different objects from various type of triangles. In this study, however, we focused solely on the third lesson plan with the structure of the lesson plan described in table 1.
Table 1. The lesson plan description.

| Indicator | Activity | Further information |
|-----------|----------|---------------------|
| Construct the 2D objects from various types of triangles; | Group discussion: The teacher gave the various type of triangles to the students and asked them to imagine what object can they make from those various triangles given. | The teacher provides three pieces of triangles for every type of it. There are seven different types of triangle namely: 1. An isosceles triangle with all of the three angles is acute angles. 2. An isosceles triangle with two of its angles is an acute angle, and the other one is an obtuse angle. 3. An isosceles triangle with two of its angles is an acute angle, and the other one is a right angle. 4. A scalene triangle with three of its angle is an acute angle. 5. A scalene triangle with two of its angle is an acute angle, and the other one is an obtuse angle. 6. A scalene triangle with two of its angle is an acute angle, and the other one is a right angle. 7. An equilateral triangle. |
| The teachers asked the students to identify another 2D plane (if available) within the object they formed. |

3. Results

The third lesson plan designed gave the opportunity for students to deepen their knowledge about the various types of triangles. The activity was making any 2D shape from various types of triangles as shown in figure 1.

![Figure 1](https://example.com/figure1.png)

**Figure 1.** Various type of triangle made by the teachers for a class activity

Before the students start making the shape, the teacher asked them to imagine what object will be made from the triangles given. In this part, the students were expected to visualise an object in their mind and the partitions of the object which consist of some triangles.

![Figure 2](https://example.com/figure2.png)

**Figure 2.** The students observed the triangles
From the video analysis, we captured some activities. The first capture was when the students took two triangles and apparently, she made a comparison between the two triangles (see figure 2a). Once she realized the triangles were not the same, she asked her friend “Where are the similar triangle?” while showing the triangle on her hand to her friend. Her friend then looked at the set of the triangles for a moment and took one of it “Here you are”. She then matched the triangles and got them matched. The second was shown in figure 2b where other student did size matching by measuring the side length of the triangle with a ruler. The third was when the others student also did size matching after he tried to compose some objects from the same type of triangles (see figure 2c). After he did size matching this student then talked to himself “Two sides of a triangle have the same side length, it is an isosceles triangle with two of its angle is an acute angle, and the other one is a right angle”.

One of the students showed that he could form four different objects from the same types and same numbers of triangles (see figure 3(a), 3(b), 3(c), 3(d)). He kept trying to form the object, and unexpectedly he could find several objects from the triangles composition. The students named the object in figure 3(a), 3(b), 3(c) and 3(d) respectively as sands’ clock, parallelogram, trapezoid and fan. In addition, the other student made a frog from various types of the triangle as shown in figure 3(e). The naming of the object showed that the students related their knowledge of the objects to their experience in their daily life inside or outside the school.

Figure 3. Kinds object that students can be made.

Another interesting finding was when the student able to form an object from several triangles as well as able to split the object into other objects. This student first made a trapezoid from three similar triangles. He then called his friend to show if he took one triangle from the trapezoid, the shape became a parallelogram, and if he took one more triangle, the shape became a triangle (see figure 4). From the activity, we can see that this student has the ability of composing and partitioning the shape.

Figure 4. Composing and partitioning triangles.

After collecting the 2D shapes, each group starts putting the result of the object they made on each of the board paper to be displayed during classroom discussion (see figure 5).
Figure 5. Students paste the objects they have made on paper board

Looking at the collection of students’ work (see figure 6) all the objects displayed are typically 2D geometric shape that students learn at schools. The objects they made during the group work activities such as frog, fans or sands’ clock were not shown on display.

Figure 6. Worksheet of each group.

4. Discussion and conclusion
The activities developed in this lesson gave opportunities for students to deepen what they know about various types of triangles through their ways of constructing the 2D shape as well as through the discussion with their friends. It is described in the result that students have some discussions about the same type of triangles, different types of the triangle and they also consider the side length of the triangle to decide whether certain triangle matched with another triangle. With the “application component of ELPSA, this lesson does not only allow students to apply their knowledge about triangle but also related it to different types of 2D shape that they have already known. It is in line with the description of [8] that the role of application helps students to be able to apply their mathematics
knowledge (i.e., triangle) to the new situation (i.e., 2D shape besides a triangle) that help to reinforce concepts and provide opportunities to scaffold understanding.

This activity promotes students’ skill of composing an object which also gave a chance for students to learn about the partition of the object. Knowledge of composing the 2D shape will make them think the shape can be cut into multiple shapes (i.e., various triangles). This partitioning skill is one of the foundational concepts that are involved in learning measure area [9]. Therefore this activity can be a good start to help students in developing their understanding about area measurement problems. There are at least five foundational concepts that are involved in learning to measure area [10]. This lesson designed involves three of those five foundational concepts namely partitioning, unit iteration and conservation of the area. The first foundation was shown from student activity in partitioning the trapezoidal into one parallelogram and one triangle or three similar triangles (see figure 4). The 2nd foundation showed from the activity of forming a 2D shape from the same types of triangles into different 2D shape. In this activity, the student arranged the triangles without overlapping and gaps to one another. The arrangement of triangles formed a 2D shape such as parallelogram, trapezoid and rectangle. The 3rd foundation showed from student activity to rearrange two similar triangles into several different objects which show that even though the object looks like different, but it was made from two triangles. This activity urges the students to recognise that, even the object looks different, the area has not changed [11]. These three foundational concepts can be a good start for the student to have the initial concept of the area that they can utilise once they learned about the area measurements.

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