The application of scaffolding augmented reality (AR) media in the sharing task learning of electrolyte and non-electrolyte solutions

S Nurrohmah1*, A Supriatna1, S S Fatimah1 and B Setiaji2

1Departemen Pendidikan Kimia, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229, Bandung 40154, Indonesia
2SMA BPI 1, Yayasan Badan Perguruan Indonesia, Jl. Burangrang No. 8, Bandung 40262, Indonesia

*Corresponding author’s email: sifanurrohmah@upi.edu

Abstract. This research is based on the difficulty of students in understanding the abstract concept of electrolyte and non-electrolyte solutions. The aim of this study is to evaluate the improvement of students’ understanding concepts with the scaffolding of augmented reality (AR) media in the sharing task learning of electrolyte and non-electrolyte solutions. This research was conducted at one of the high schools in Bandung, Indonesia. Data were obtained through questionnaire understanding the concept of electrolyte and non-electrolyte solutions and student’s worksheets. Data were analysed quantitatively and qualitatively. The results define students’ conceptual understanding from each question indicator obtaining positive results. It can be concluded that the application of scaffolding augmented reality (AR) media in the sharing task learning of electrolyte and non-electrolyte solutions enhances understanding of student’s concepts.

1. Introduction
Chemistry learning in schools has a lot of important materials that must be studied. One of the materials is electrolyte and non-electrolyte solution which is an essential material to support another material. Researches on the concept of electrolyte and non-electrolyte solutions have been found and almost students have difficulty to understand the abstract concept [1]. The reason for the learning difficulties above made students only remember concepts without understanding them more deeply [2].

In a didactic situation, the teacher has a role to build students’ knowledge by beginning the teacher to present issues that are contextual and so on. This will be information for students so that the creation of a new situation. But if the student is unable to explain what he is facing, then the teacher can use scaffolding techniques to bring up student responses so that new situations occur [3]. In the scaffolding stage, the teacher helps students master the tasks or concepts that students cannot understand themselves. The teacher provides assistance only to abilities not mastered by students. When students have mastered the concept as a result of scaffolding, scaffolding can be erased and then students can master the task as a whole.

Therefore to scaffold students’ understanding abstract concepts in electrolyte and non-electrolyte solutions, requiring submicroscopic understanding of that concept is demanded with the scaffolding AR media applied in sharing task learning. In sharing there is cooperation between groups, between students
in groups and with other groups, and help each other friends who have difficulty. Sharing task learning is an individual task through a small collaborative group containing basic level textbook materials that must be understood by all students and can facilitate collaboration among students [4]. In order to give maximum effect at the sharing stage, effective activities are needed that are able to make students’ understanding process (both low, moderate, and high ability students) will be relatively the same in terms of concentration and seriousness when doing learning process [5]. Sharing task is also an activity when students learn from each other, therefore there is a relationship of mutual learning, mutual respect, a difference of opinion and gently responding when is asking for scaffolding [6]. Sharing task learning can be benefit to all students both students who have low cognitive abilities, moderate, and students who have high cognitive abilities [7]. In sharing task learning activities on the class of students, student worksheets are afforded. It is regarding electrolyte and non-electrolyte solution material with the scaffolding AR media.

2. Methods
This research was conducted at one of the high schools in Bandung with 32 students of grade X. Data were analysed quantitatively and descriptive qualitatively. The instruments utilized were test questions the understanding of students on the concept of electrolyte and non-electrolyte solutions and student’s worksheets with the scaffolding AR media.

3. Result and Discussion

3.1. Sharing task students
Figure 1 shows a student’s worksheets on the sharing task that consists of four questions related to the core concepts of electrolyte and non-electrolyte solution material. Figure 1 defines that students are given questions to discuss with their group friends. The lamp flame test was carried out using a sample of substances that were well-known to students everyday namely samples of sodium chloride solids, sodium chloride solutions, acetic acid solution, and sucrose solution. These samples are utilized to introduce the term strong electrolytes, weak electrolytes, and non-electrolytes by comparing the results of the flame lights in all four samples. Such predictions of student responses, almost all students have difficulty to explain the ionization process that occurs in the four samples tested, so the teacher anticipates it by giving a submicroscopic image of the four samples through submicroscopic animation based on AR. This is intended to foster motivation and enthusiasm of students in answering when students are faced with things that are technological sophistication they will be easier to understand and easier to analyse the four samples.

(a) Why sodium chloride solids cannot deliver an electric current (the lamp does not turn on)?

(b) Why sodium chloride solutions can conduct an electric current (the light up brightly)?

(c) Why the acetic acid solution produces a dim light?

(d) Why the sucrose solution does not produce light on the lamp?

Figure 1. Sharing task given to students

Overall, students can answer the process decomposition process of ions in NaCl substances in water. However, students have difficulty in explaining the ionization of weak and non-electrolyte electrolyte substances. The teacher confirms the answer by using the AR application as an aiding to make it easier
for students to understand the material through submicroscopic animation using a cell phone to several student learning groups as shown in the following Figures 2, 3, 4 and 5.

![Figure 2. Teacher assistance in group 3](image1.png)

![Figure 3. Teacher assistance in group 6](image2.png)

![Figure 4. Group sharing activities 7](image3.png)

![Figure 5. Group sharing activities 1](image4.png)

3.2. Scaffolding augmented reality media

The teacher facilitates students to utilize the application of AR media as an aid to make it easier for students to understand the material through submicroscopic animation utilizing mobile phones. It is seen that students are very enthusiastic and have high curiosity in analyzing submicroscopic. The results of the analysis of recording transcripts, videos, and observations, all students felt happy and amazed when using the application so as to foster enthusiasm in learning and facilitate students in answering each challenge given by the teacher. Students learn about the submicroscopic dissolution process. The media for AR utilized in learning are sharing task electrolyte and non-electrolyte solutions, namely NaCl solid, NaCl solution, CH$_3$COOH solution, and C$_{12}$H$_{22}$O$_{11}$ solution as a whole can be seen in Figures 6, 7, 8, 9, 10, 11, 12 and 13 following.
Figure 6. Marker of NaCl solid

Figure 7. Molecular of NaCl solid

Figure 8. Marker of NaCl solution

Figure 9. Molecular of NaCl solution

Figure 10. Marker of CH$_3$COOH solution

Figure 11. Molecular of CH$_3$COOH solution
3.3. Student concept understanding test

Table 1 defines indicators of understanding concept tests that were tested on 32 students of grade X. Tests for understanding students’ concepts in this study were carried out at the beginning and at the end of learning which were drilled by questions regarding understanding students’ concepts in electrolyte and non-electrolyte solutions (Table 1). Also presented is the average of the test results of understanding the concept of students in electrolyte and non-electrolyte solution material (Table 2).

**Table 1. Indicators of understanding the concept of electrolyte and non-electrolyte solutions material**

| No | Indicator                                                                 | No Problem |
|----|---------------------------------------------------------------------------|------------|
| 1  | Analysing the ability of electrical conductivity of solutions in everyday life phenomenon | 1          |
| 2  | Grouping strong electrolyte solutions, weak electrolytes and non-electrolytes based on experimental data | 2          |
| 3  | Analyzing electrolyte dissolution processes strong, weak electrolytes and non-electrolytes in water based on figure | 3a         |
| 4  | Writing down the reaction equation for solutions strong electrolyte, weak electrolytes and non-electrolytes in water based on figure | 3b         |
| 5  | Sorting the electrical conductivity of the solution based on water solubility | 3c         |
| 6  | Analysing ionic compounds can deliver electric current based on figure | 4          |
| 7  | Identify the type of compound bond that can deliver electric current      | 5          |

**Table 2. The average test of understanding the concept of electrolyte and non-electrolyte solution material**

|          | The first understanding test of concept | The last understanding test of concept | N-gain |
|----------|----------------------------------------|---------------------------------------|--------|
| Average  | 32.47                                  | 73.34                                 | 0.61   |

Table 2 defines the average value of understanding students’ concepts from the first and the last students of grade X. The average value of the first understanding students’ concepts to the last student in electrolyte and non-electrolyte solution material overall it occurs increase from 32.47 to 73.34 and n-gain around 0.61 included a medium category. Based on identification results explain that the average value of the first understanding students’ concepts to the last occur increase.
4. Conclusion
This research applies the scaffolding of AR media in sharing task learning on electrolyte and non-electrolyte solution materials. Sharing tasks are given to each student learning group with the scaffolding of AR found on students' handsets proved to facilitate students in understanding the concepts learned. Utilized AR media, namely marker of NaCl solid, marker of NaCl solution, marker of CH₃COOH solution and marker of C₁₂H₂₂O₁₁ solution. It increases the understanding of students' concepts as evidenced by the test results of understanding student concepts the final test and the percentage of tests understanding students’ concepts each indicator achieved positive results. It was concluded that the application of AR media to the sharing task of electrolyte and non-electrolyte solutions increased the understanding of students' concepts.

5. References
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