International Conference on Mathematics and Science Education
of Universitas Pendidikan Indonesia
Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

Collaborative lesson design of acid base titration curve in Indonesia senior high school

M Amzar[1*], S Hendayana[1], W Wahyu[1], A Supriatna[1] and S Lestiyani[1]

[1]Departemen Kimia, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

[*]muharaniamzar@gmail.com

Abstract. Acid base titration curve is one of the important topics in Indonesia senior high school chemistry. Base on interview with chemistry teachers from different province, the study revealed most of the teachers disregarded this topic, because they got difficulties to find the best strategy to teach the topic effectively and efficiently. The purpose of this study is to develop a collaborative lesson design based on sharing and jumping task of acid base titration curve at the senior high school level in Indonesia. The topic of acid base titration curve can promote high order thinking skills of the student how to present and to communicate data of acid base titration. The methodology used is didactical design research (DDR). Didactical design research has tree steps are, (a) analyzing didactical condition before learning, (b) analyzing metapedadidactical and (c) analyzing retrospective. Data were collected by interview teacher from different provinces, recordings (audio). The lesson design has been develop, include learning target, prediction student response, and teacher assistance. The developed lesson design will be implemented at grade 11 of senior high school in Bandung.

1. Introduction

Before 2016, implementation of chemistry curriculum in Indonesia senior high school replaced acid base titration curve before buffer solutions and hydrolysis. Teachers found it difficult to make their student calculate the pH of each curve point. Most teachers only explained the type of titration curve without making the student directly involved in calculating the pH of each curve point. They did not realize that acid base titration curve, can promote high order thinking skills of the student how to present and to communicate data of acid base titration. Besides that, it can review the students' conceptual knowledge of buffer solutions and hydrolysis. Acid base titration curve is one of the important topics in Indonesia senior high school chemistry. Indonesia changed the order of chemical topics in the National Curriculum. Acid base titration curve is taught after the student learned buffer solutions and hydrolysis, with the aim to overcome acid base titration curve problems. But it is not easy to change the teaching style that have been applied for years. Especially to describe eight types of titration curves take a long time. We need to design a lesson design that is able to achieve the objectives of acid base titration curve learning. One of the learning design that can be used is collaborative didactic design which is Lesson Study learning strategy. The purpose of education as a learning goal or special ability to be achieved equally for all students, therefore the teacher must develop critical aspects to make the planning and analysis of learning [1] given the disparty of students' abilities, it is necessary to facilitate among students learn each other in one group to achieve the learning objectives efficiently and effectively in saving time [2] called collaborative

Teacher assistance can be in the form of questions, directions, or guidelines to guide students to achieve a desired understanding of the concept. The collaborative learning by Maasaki [3] is a group-based learning aimed at encouraging students in groups to find diverse opinions or thoughts by each

Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

individual in the group. In collaborative learning there is a relationship between students who have high academic ability and students who are less in academic ability. Relationship of mutual learning is a two-way learning and there are reciprocity and provide benefits for both students who understand and who do not understand. With "mutual learning relationship" is expected that students can be more active again in learning activities.

In the learning activities involves a variety of students understanding, therefore the teacher designed the learning by using two types of tasks, namely the sharing task, is an individual task through small group collaboration that contains the basic materials of textbook level and must be understood by all students, and the topic of jumping task is a problem given to increase higher student ability. The problem with the jumping task contains the basic material that has been developed (beyond the textbook level) i.e., the application material from the basic concept [4]. In learning sharing and jumping task can benefit all students either students who have low cognitive abilities and students who have high cognitive abilities. It is not only improve the cognitive abilities of students, but also train the affective and psychomotor aspects of students

Based on observations made by interviewing several chemistry teachers, analyzing the lesson design used, and analyzing the results of research conducted by Resti Tri Astuti [5], it appears that students have not been able to describe and analyze acid-base titration curves. In addition, in the learning process many teachers skip learning the basic titration curve material or simply explain it briefly. Whereas students get strengthening in concept of previous learning material, hydrolysis and buffer through topic of acid-base titration curves. One of the student obstacles is student could not understand the concept acid-base titration curves due to teachers explained briefly the topic of acid-base titration curves. To improve the quality of learning on the topic, we need a learning models that attracts students' interest, that student learning can be effective and efficient. One of the learning models that can be used is collaborative didactic design which is a Lesson Study learning strategy.

In a lesson study the knowledge product is a lesson plan [6]. From the reading of the literature, our understanding is that this is a rather detailed plan that entails teacher and student actions, learning activities and anticipated student reaction [7-10]. The lesson plan is an instructional product that should guide “action towards helping students achieve the learning goals”, and present “the shared knowledge about how best to do so”[6]

Based on the above problem, the researcher is interested to do research by designing the learning through didactic design by using didactic design of collaborative sharing task and jumping task based on Lesson Study on the topic of Acid Base Titration Curve designed collaboratively by researchers and teachers.

2. Experimental Method

2.1 Design research

The design used in the form of didactical design research (DDR). The activities of didactical design research consist of three steps, there are : (1) Analysis didactical situation before learning process in the form of didactical design hypotheses include didactical and pedagogic anticipation, (2) Analysis during learning (metapedadidactical), and (3) analysis retrospective is analysing relationship result analysis didactical situation hypotheses with result metapedadidactical [11].

2.2 Method

This study, review literature on didactic design and collaborative learning (sharing and jumping task), and analyze previous research, analyze the concept of acid-base titration curve with teacher of field of study and lecturer, interview teachers to find out students' learning difficulties on the topic of acid-base titration curve, observe learning activities of one school in Bandung, analyze the results of teacher interviews to identify student learning obstacle. Prepare the lesson plan in the form collaborative lesson design based on student learning obstacle.

Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

2.3 Subject of research

The result of collaborative lesson design of acid base titration curve had been implemented at grade 11 of senior high school on even semester of academic year 2017/2018 at SMA LabSchool UPI in Bandung.

2.4 Data collection and analysis

To collect information about previous lesson of acid base titration curve, 25 teachers from different province were interviewed using phone call and were recorded. The chemistry teacher's phone number was obtained from social media group whatsapp "working on chemistry" and social media group telegram "association of chemistry teacher of Indonesia", because the first author is a chemistry teacher who joined in those group. The results of interviews in the transcript to identify the learning process that has been done by the teacher and the obstacles encountered during the learning process.

In addition, the observations were made by analysing the –lesson plan of acid base titration curve used in the National Curriculum. Furthermore the author conducted preliminary research on learning activities in one of school in Bandung that will be implemented by our lesson design.

3. Results and Discussion

Several teachers described the problem of acid base titration curve learnings. Students couldn't draw acid base titration curve, because they didn't understand to figure out pH of different titration conditions. Teacher did not have enough time for explain all those curves. From analysis of RPP, there are not predictions of student response and anticipation for that. Base on observations of learning activities, students were not directly involved in learning.

To overcome these problems, the author designed a collaborative learning design. The collaborative lesson of acid base titration curve was design as follow. It was arranged a task to be carried out by all students, which leads to interaction between students and peers. Because in collaborative learning, applied learning strategies with a number of students as members of the study group, and each member of the group must cooperate actively to achieve the objectives that have been determined so that the process of learning that is full of meaning [12].

Group tasks designed, given in the form of envelopes. Each envelope aims for students to cooperate in making acid-base titration curves. Each envelope will form a different curve. For example the first envelope contains the task of making a weak acid titration curve by a strong base, and then the second envelope is tasked to create a strong acid-titration curve with a strong base. Each group receives one envelope, so each group automatically creates a different curve. Sample contents in one envelope can be seen in figure 1

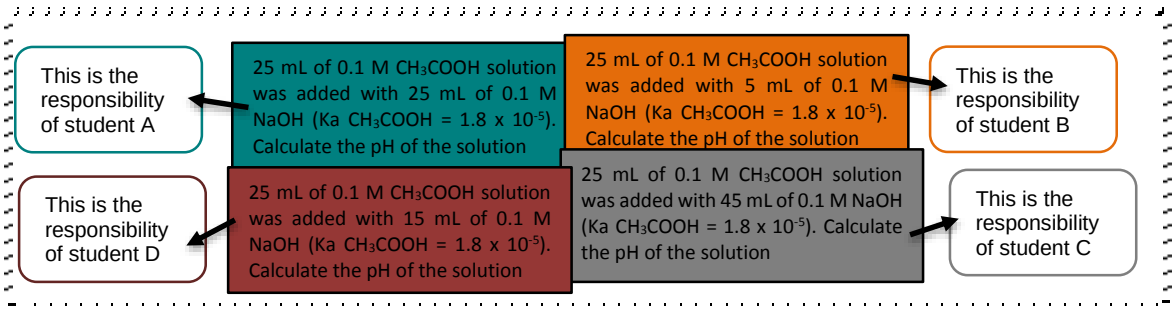

Figure 1. One envelope containing different colour question cards (CH_3COOH titration by NaOH)

Figure 1 shows that the envelopes contain several cards about titration data. Number of envelopes based on the number of groups in a class. And each envelope consists of 16 question cards, each 1 question card contains 1 titration data. We can see for example, strong base titration data and weak acid. 10 mL CH_3COOH solution was titrated with 25 mL of NaOH 0.1 M. it is grouped into four different colors. Four question cards will have the same color. All data from the question cards residing in the same envelope is the titration of the same base acid. For example, the envelope I is the titration data of Weak

Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

Acid and Strong Bases, all cards have the same weak acid volumetric information, but different of strong base volume (same concentration), so each card will have different pH.

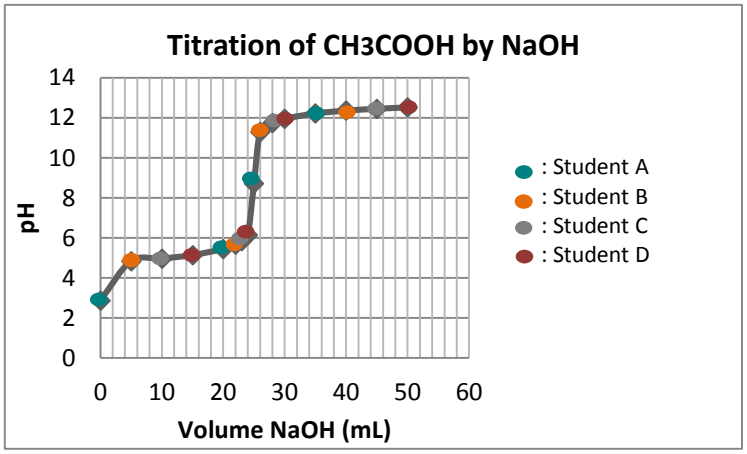

Figure 2. Curve of CH_3COOH titration by NaOH

Figure 2 shows the interpretation of one group titration data presented in curve. The curve shows that each student plays a role in processing the titration data. Each student is responsible for completing four question cards (same color). Each student will get a problem card whose volume of NaOH is not sequential, because in calculating the pH of the curve point there is the concept of buffer and hydrolysis solution. It is hoped that one student will get a solution card using the concept of buffer solution and other point of completion using the concept of hydrolysis. If in a group there are students who can't complete their personal responsibilities then it is expected that students who have a higher ability to give assistance to their friends, because if not, then the group will not be able to create a titration curve because there are some incomplete points. It occur the sharing task and scaffolding from peers.

After successfully making acid-base titration curve, students are expected to be able to determine the right indicator on each titration based on curve analysis presented in front of class. Students' ability in analyzing and communicating curves so as to determine the right indicator for each titration curve is called a jumping task.

The entire learning process is summarized in the form of lesson design. Lesson design is a detail of the selected steps and anticipations prepared to face predictions of possible student responses that aim to minimize identified student learning obstacles [13]. A good learning environment will help students achieve their potential abilities [14].

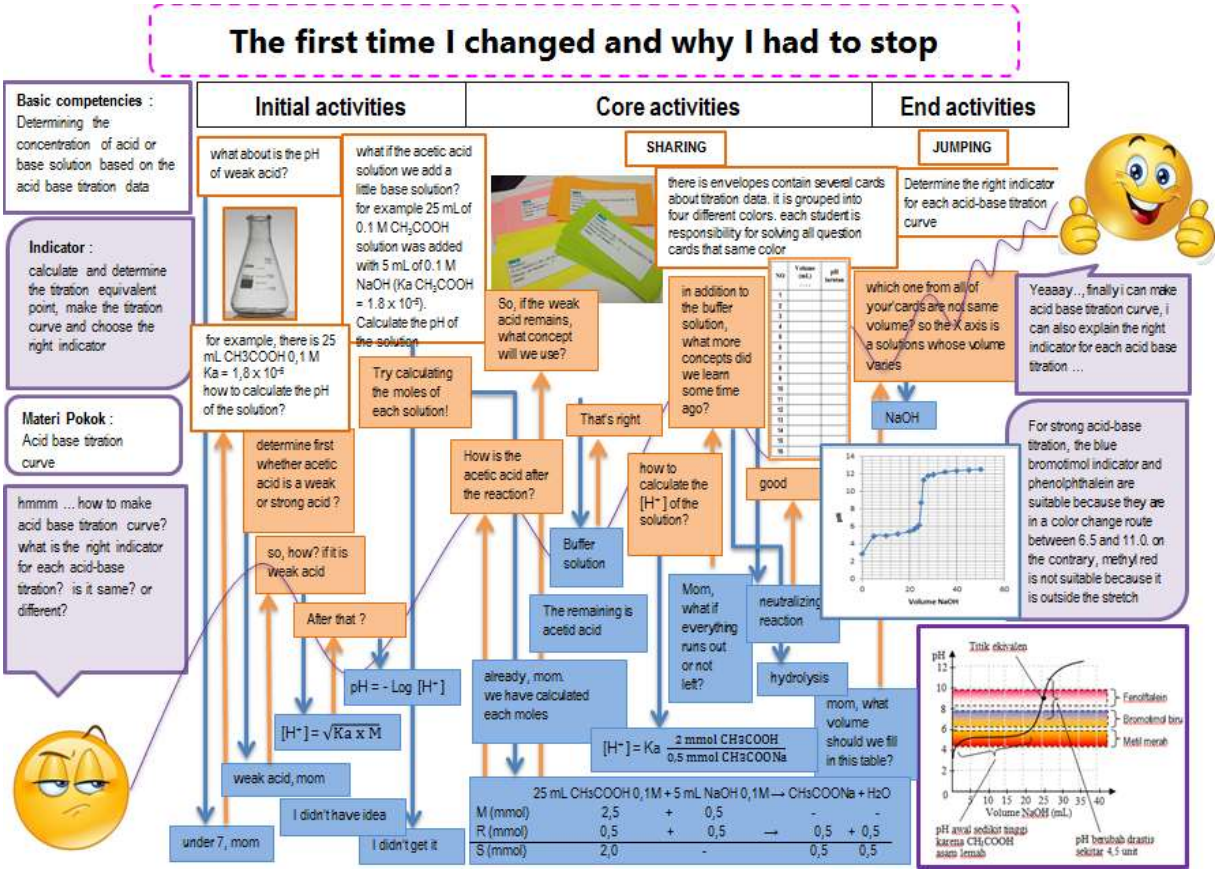

Figure 3. Collaborative lesson design of acid-base titration curves

Figure 3 shows that the lesson design consists of three stages: the initial activities (apperception), the core activities (sharing) and the closing activity (jumping). In the core activities of sharing activities that facilitate students in developing potential development, while the closing activity is a jumping task activity. Concepts that will be taught to students are placed on the upper left side. The orange upper area represent teacher's anticipation, while the blue bottom area represent predictions of student responses. The more students' responses mean the student centered learning activities. The lower left side is the face of the student before the learning. The upper right side is the face of student after learning. To fill the student's feelings, the teacher imagines as if they are students to understand that while in the learning. Based on the explanation it can be concluded, the all activities in learning are covered in a piece of paper.

This early activity in collaborative learning is called sharing. In sharing the cooperation between students in a group to complete the task together, students ask for help peers and teachers. Learning-based sharing task is a lesson in accordance with textbooks. The important thing is that every student really understands the content of the topic. By working on an activity with all members, then the activity will be student-centered and provide greater benefits to students who do not understand.

Students are expected not only sharing but also experiencing jumping understanding. But jumping does not happen if there is no sharing in learning activities. Jumping that occurs in the students not only focuses on students' understanding but also the habits or behavior of students during the learning activities. For example, students who are initially spectators or silent will change in the direction they can give their opinions in learning activities.

Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

4. Conclusion

Lesson design is made in such a way that teachers can anticipate each student's response to reduce student learning obstacles. This learning design is expected to benefit students to strengthen the concept of buffer and hydrolysis solutions, train students' critical thinking skills in presenting and communicating data, make learning time more efficient and effective, interaction occurs among students.

5. Acknowledgement

This research is supported by education department of Riau province and Universitas Pendidikan Indonesia. And a special thanks to chemistry teachers who participated in this research

6. References

[1] Marton F, Pang M F and Tsui B M 2006 On some necessary conditions of learning. *Journal of the Learning Sciences* **15** (2) 193-220
[2] Gevers J M P, Rutte C G and Eerde W V How Project Teams Achieve Coordinated Action: A Model of Shared Cognitions on Time *in Time in groups*. Published online: 08 Mar 2015; 67-85
[3] Masaaki S 2014 *Dialog dan kolaborasi di Sekolah Menengah Pertama: Praktek* "*Learning Community*". Jakarta : PELITA
[4] Sato M 2013 *Mereformasi Sekolah: Konsep dan praktek komonitas belajar*. The Internasional Development Center of Japan Inc., Tokyo
[5] Astuti R T 2015 *Desain Didaktis Pembelajaran Titrasi Asam Basa didasarkan Hasil Refleksi Diri Guru melalui Lesson Analysis*. Retrieved from respisitory.upi.edu
[6] Morris A K and Hiebert J 2011 Creating shared instructional product: an alternative approach to improving teaching. *Educational Researcher* **40**(5) 5-14
[7] Arani M S R, Keisuke F and Lassegard JP 2010 Lesson study as professional culture in Japanese schools: an historical perspective, *Japan Review* **22** 171-200.
[8] Lewis C 2002 *Lesson study: A Handbook of Teacher-Led Instructional Change*, Research for Better Schools Inc, Philadelphia, PA.
[9] Yoshida M 1999 *Lesson study: a case of a Japanese approach to improving instruction through a school based teacher development* unpublished doctoral thesis, The University of Chicago, Chicago, IL.
[10] Yoshida M and Fernandez C 2004 *Lesson Study. A Japanese Approach to Improving Mathematics Teaching and Learning*, Lawrence Erlbaum Associates, Mahwah, NJ.
[11] Suryadi D 2010 *Didactical Design Research (DDR)* dalam pengembangan Pembelajaran Matematika1. Makalah Seminar Nasional Pembelajaran MIPA di UM Malang.
[12] Barkley E F Cross K P and Major C H 2005 *Collaborative Learning Techniques: A Handbook for College Faculty.* San Francisco: Jossey-Bass
[13] Suzuki R 2015 *Sharing best practice lesson study* dalam peningkatan mutu pembelajaran. Disajikan pada seminar hasil penelitian dan pengabdian kepada masyarakat unggulan. Bandung: Universitas Pendidikan Indonesia.
[14] Vygotsky L S 1978 *Interaction between Learning and Development.* New York: W. H Freeman and Company