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Sharing and jumping task design on chemical equilibrium lesson for improving learning quality at senior high school

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Abstract. Lack of teacher anticipation of students responses lead to obstacles in a learning process which affect the quality of learning, therefore we need develop an innovation of learning design that has prediction of student's response. The purpose of this research is to develop didactical design based on sharing and jumping task in chemical equilibrium calculation. Sharing task used to facilitate students slow learners with help fast learners. While jumping task used to challenge fast learners so they didn't feel bored in learning. The method used in this research is the *Didactical DesignResearch* (DDR), which consists of three stages: prospective analysis, metapedadidactical, and retrospective analysis. The developed didactical design was implemented at students of grade 11 of a senior high school in Bandung. Then the revised didactical design was implemented at another group of students of grade 11. Data was collected through observations, interviews, documentation, then the data is transcribed and analyzed. Based upon the result of the first implementation analysis it was found that the teacher still dominated the learning proses, but in the second implementation of the revised didactical design affected some changes in the learning process indicated some students have started to discuss actively.

1. Introduction

Based on the results of interviews to some teachers, learning process frequently has some distractions that make students become unmotivated/non-maximum to learn the materials. It is influenced by lack of motivations, making and using inappropriate lesson plan and the learning process which is still centered to the teachers [1,2]. Lessonplanthat used by the teachers recentlyis one of the quality learning factors based on the learning process [3].One of the steps to increase students' learning quality consists of; inventing an innovation lesson plan which is known as didactical design that created based on student response prediction and teacher's anticipation[4]. A teacher must be able to identify learning difficulties which have been faced by students in order to make a help prediction of what must be conducted to solve some learning difficulties, so that evoke students' interaction with the other students or the teachers [5]. The invented didactical design will be used to sharing and jumping task that are collaborated with collaborative learning. In sharing task, whose can attain the amount of benefits from this process is the fast learner, however, the jumping task will be sensed by the slow learner, because it is out of our awareness of learning process "from understanding to the application" and also there are some students who can through the learning process contrary "from applicationto understanding" [6].

In general, the purpose of this research is to obtain didactical design on sharing and jumping task in chemical equilibrium calculation topic.Based on the background above, the research formulation is "How is didactical design based on sharing and jumping task developed in chemical equilibrium calculation topic?". This research also tends to answer the following question: *How is didactical design based on sharing and jumping task become the design solution of innovative learning?*

2. Method

This research design is using *Didactical Design Research* (DDR)through three phases of analysis, prospective analysis, metapedadidactic analysis and retrospective analysis. The subjects of this researchwere students senior high school in Bandung.Data was collected through observations, interviews, documentation, then the data is transcribed and analysed.

3. Result and Discussion

Based on the analysis result of national examination questions in the late five years, the frequent revealing topic is chemical equilibrium.

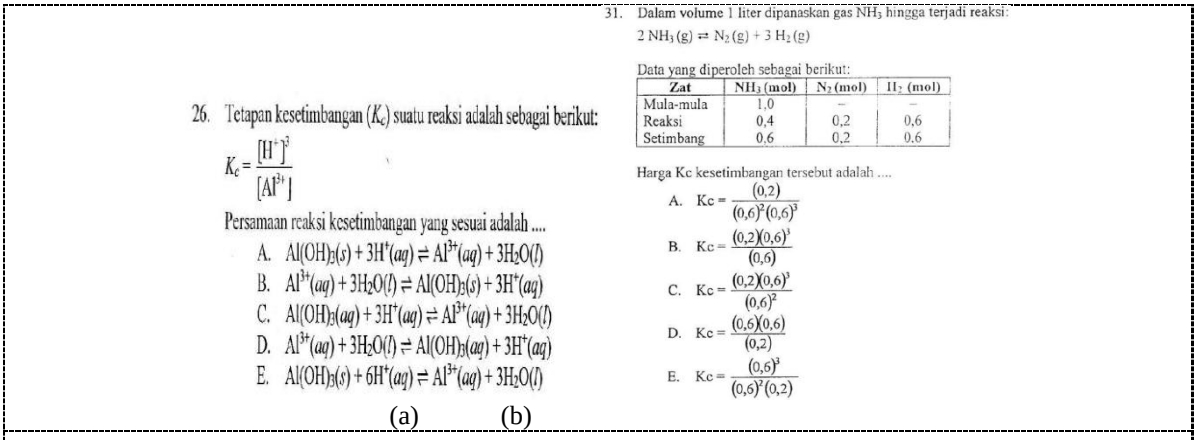

Figure 1. Questions of chemical equilibrium in the national exams on 2016 (left) and 2013 (right)

Figure 1 shows of chemical equilibrium that often appears on the exam is one of the problems related to the calculation of chemical equilibrium. First thing that students should do in this sub-topic is student must be able to determine the connection between the reagents with reaction products of the reaction process and performing calculations and the students must be able to process the data to determine the equilibrium constant value of the reaction [7]. The student's greatest difficulties in the current concept including compilation must relate to mathematical concepts with the underlying chemical concept [8-11]. During the learning process, teachers often use Lesson Plan to make it easier for them to teach. The stage of learning activity in lesson plan is only contains details of general activities. Based on the results of lesson plan analysis, it found some weaknesses. First, there is no special points on the detail of activities in the lesson plan which is makes the teachers should be ready to teach 100%. It is because when teachers forget they will not be able to see the lesson plan anymore. Second, there is no prediction of student responses and teacher anticipation during the learning process. It resulting lose concentration of teacher when they were teaching because the teacher is not ready to answer and respond to student responses that are unexpected responses and questions..

Table 1.transcript of teacher interview

Subject	Dialogue
A	what are the student learning barriers when studying chemical equilibrium topics?
B	barriers occur when students write the equilibrium equilibrium formula. Most students do not pay attention to phases when writing chemical equilibrium constant formulas so that the formulas for homogeneous compounds are the same as heterogeneous compounds. For calculation problems, students will be easier to work if the concentration when equilibrium is directly included. When on the question there is only the first mole and the mole react, the student will be confused when looking for concentration at equilibrium.For calculation questions, students will be easier to work if the immediate concentrations are directly included rather than the initial mole and the reacting mole. In the initial activity students have been reminded when reactant reacts will decrease while the product will increase. but they often forget the principle
A	what are the main factors that create learning barriers when students study the topic of chemical equilibrium?

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B	because this topic is always studied at the end of the semester and the time provided for teaching too little so that the learning process is not maximal.the learning process used usually does not make students look for and find themselves the principle of chemical equilibrium. because I think "how to teach a lot of topics to students with limited time?"

Table 1 is an interview transcript a chemistry teacher which tells about their feelings while teaching chemical equilibrium topic. Dealt with the interview transcript, it can be concluded that the learning process about this chemical equilibrium has not been resulted an optimal study plan because the proper topic is huge but there is a limited time. Nowadays, the teacher must be able to acknowledge the essential materials from a topic so they can conclude and bound some chosen materials to the students. On the strength of the analysis result which has been done, it can be concluded that there is such a further need to make an innovation to the study plan. Based on the results of the analysis, there is one conclusion. We, as a teacher need to make an innovation about the learning design, it is didactical design that created based on on student response prediction and teacher's anticipation[12].

The differences of didactical design with lesson plan that used are; first, the learning section in didactical design is not only reveal the teacher's way of teaching a topic but also emerge some student response predictions so as the teacher can enhance their ability to anticipate the student response predictions. Second, in this perception section, the teacher gives a real phenomenon that make the students need to identify and analyze the phenomenon. It aims for increasing the student motivation of learning chemistry. And third, didactic design is not only focused on the teaching and informing the materials but also cogitate the student response predictions and find out the anticipations. The use of didactical design will affect the teacher's ability to analyze the essential materials of a concept.

Table 2. Silicon group learning transcripts

Time	Subject	Dialogue
08:52	S2	so the chemical equilibrium reaction is?
08:54	S3	should be related to the rate?
08:58	S2	what rate?
09:07	S2	so, when the same rate or the direction of chemical reactions are the same?/
09:11	S3	direction of reaction
09:12	S2	okay, so the same reaction direction
09:25	S1	how to compose the sentence?
09:28	S3	the equilibrium reaction occurs when the reaction direction of N2O4 and NO2 is the same
10:18	S1	terms used reagents and products right?
10:19	S2	yes
10:20	S3	the direction of the reaction equal or same?
10:22	S2	equally

Table 2 shows the first didactical design learning transcript of silicon's group which show the interaction between students when searching out the definition of chemical equilibrium. In accordance with the transcript seems that the students are confident and enthusiast to start the discussion and express their own arguments, yet at the beginning of the learning process whose the teacher has not been able to show student's curiosity then the interaction is only occurred for a while and out of the conclusion section

(a) (b)

Figure 3. Sharing activities in the silicon group

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Figure 3 shows the students' interaction while in the learning process, 3.ashows a student is teaching the other students who have not understand yet. Whereas, 3.bshows the discussion section in some groups of student. Dealt with those figures, it can be seen that the students are being aware of others when having a discussion. The students begin to be usual to have a group discussion while tackling a test which given by the teacher, because of the discussion, some answers will be found from the different arguments. Besides, the discussion process teaches the students to have a self-reliance of caring the others, understanding and listening to the fast learner student who has been understood the materials

Table 3. Silicon and chlorinegroup learning transcripts

Time	Subject	Dialogue
20:20	S2	why the sentence is not good?
20:25	S1	is the product always left?/
20:27	S3	yes
20:35	S1	where is the reagent?
20:37	SL4	more easily see the arrow, the compoundnear the mouth of the arrow called the product
20:40	S2	oh, now stay put into the formula
20:42	SL4	yes, so the [product]^{a} divided by [reactant]^{b}
21:57	S2	[reactant]^{b}

Table 3 shows a transcript of learning process to the silicon's group which shows the interaction with the other groups when trying to find constant-equilibrium formula (K_c). Based on the transcript, seems revealing some discussions between silicon group and chlorine, along with unsatisfied feeling to the obtained answers from the group discussion then the students ask to the other group. Sharing task is useful to facilitate the learning process of students who have low ability. Students are expected to solve problems in the form of questions on the student worksheet (LKS) on the principles. How to process data and determine the connection between reagents and products in equilibrium [5,1].

The first didactical design only reveals some sharing tasks, those are five groups using sharing task between the students and four groups using sharing in the groups, whereas, the jumping task which has been prepared by the teacher cannot be revealed, because of the limited time; the interaction was only conducted by 2-3 students. Thus, not all the students will try to think, analyze and assign of what have been seen and sensed in the interaction. Based on the weaknesses of the first didactic design learning process then must be done some alterations into didactic design, that the first activity need to be created briefly and choose the efficient sharing activity hence it can be obtained the revision of didactic design. Didactical design that has changed to some parts, first the main activity and the sharing task of the revised didactic design which made into simpler and effective to get the efficient time, andsecond the anticipation design and teacher's help are made in more directed and perfect

Table 4. Phosphor group learning transcripts

Time	Subject	Dialogue
17:36	S3	so Kc?
17:39	S4	so what's the point? does it mean N_2 and H_2 are reactants and NH_3's products? or how?
17:56	S2	yes [N_2] [H_2] is a reagent and [NH_3] is a product but []^{n} what does it mean?
18:07	S1	what are you doing?
18:10	S4	if it will be made the general formula, the answer "product concentration divided by reactant concentration"
32:41	S1	BaO is the first written reagent?
32:45	S4	yes, but for BaO not written because the phase of the compound is solid. now look for compounds or elements that have a gas phase
32:52	S1	BaO?
32:55	S4	No, from the equation of this reaction where is the compound or element having the gas phase, see the sign

Table 4shows the revised didactic design learning transcript of the phosphor's group which indicates student's interaction. Based on the transcript, it seems that all of the students are joined the group discussion despite of the interaction, students scarcely ask a simple question or argument, but when S4 tackling the confirmed answers, there is no positive response from the other students. Furthermore, when the time at 32:41 to 33:26 then we can see the student's emotion of caring each other while discussing the materials that is when the student willing to explain the previous materials to the other students who have not understand yet; for instance, S4 that attempts to explain about a compound phase to S1.

(a) (b)

Figure 4. Sharing activities in the phosphor group

Figure 4 showsthe student's interaction in the learning process,4.a indicates a student who teaches the other students (who have not understand yet), while 4.b indicates a student who discusses with the other group. Based on those figures, show the occurrence activity in the discussion section, it can be seen the student's sense of caring each other is getting higher. The students who have not understood are more confident to ask the material to the other students. Figure4.b shows the interaction between magnesium and chlorine group's which occur spontaneously because when the magnesium group are discussing, suddenly the chlorine group bends on them to join the discussion. It occurs because the students aren't satisfied with their own discussion result.

Table 5. Jumping task at phosphor group

Waktu	Subject	Dialogue
1:09:55	S4	reagents will turn into products. In the initial reaction there are 0.5, 1 and 0.5 but before answering the question consider the coefficients on each reactant and product, what coefficients are the same or different? if the mole that reacts to "A" is 0.5 mol, "B" is 1 mol because "B" has "coefficient 2" while in "C" and "D" the reacting mole is 0.5 mole, how to find a mole when equilibrium?
1:11:39	S1	0,5
1:11:50	S4	negative or positive?
1:11:50	SI	Negative
1:11:51	S2	Positive
1:11:55	S4	because the first mole does not exist then when it reacts it has 0.5 mol. now the concentration we get is already in equilibrium?
1:12:10	S1	Not yet
1:12:12	S4	this is a starting mole, this is a mole when it reacts and this mole is at equilibrium. To find the kc we need is a balanced moment concentration. Look at moles as equilibrium for NH_3, $N_2$and $H_2$is 0,5 mol and 1 mol, whether 0,5 mol is the concentration?

Table 5 shows the jumping task transcript which occurs in phosphor group. Grounded on the transcripts, it can be concluded yet S4 still becomes the leader then the jumping task is happened to S2 physically. In the beginning, S2 have not joined the discussion then they join the discussion on the last activity, to solve the questions.The Jumping task is made to challenge the students who have high ability so that they do not quicklyfeel bored during the discussion process [5,1].This revised didactical design learning process evokes sharing task to six groups whether to student's sharing or group's sharing,the occurrence interaction in the discussion has been done by all of the students although the confirmed questions in the discussion are simple, and the jumping task has been prepared bythe

teacher is perfectly revealed yet the jumping task interaction is not vast enoughas in the sharing task because lack of student's understanding to answer the questions.

4. Conclusion

The making of didactic design which qualified to the students is resulted from two implementations. Based on the analysis result of didactic design learning transcript can be concluded that the learning quality of students is increased than the previous learning quality. It can be observed from; first, the number of interactions which have done by the students or the group's interaction. Second, are the revealing of caring each other, curiosity and self - reliance.Third, they are familiar with the discussion section. The resulted didactic design is not significant to change the student's view because there are some students who have not motivated to do a discussion either nobody asks them to join the discussion or lost of desire to join a discussion. Therefore, it still needs some alterations to this didactic design in order to gain the best quality of learning process.

5. References

[1] Hendayana S, Suratno T, Supriatna A and Nusantara F2016 *Bercermin dariPembelajaran*
[2] Kemendikbud 2016 Silabus Mata Pelajaran Kimia SMA/MA Jakarta
[3] Siegle D, Rubenstein L and Mitchell M 2014 Honors Students' Perceptions of Their High School Experiences: The Influence of Teachers on Student Motivation *National Association for Gifted Child Quarterly* 2014, Vol 58(1) 35–50
[4] Ghirardi M, Marchetti F, Pettinari C, Regis A and Roletto E2013A Teaching Sequence for Learning the Concept of ChemicalEquilibrium in Secondary School Education *Journal of Chemical Education*
[5] Maasaki S2014*Dialog dan Kolaborasi di Sekolah Menengah Pertama "Praktek Learning Community"*
[6] Ilhan N, Yildirim A and Yilmaz S2016 The Effect of Context-based Chemical Equilibrium on Grade 11 Students' Learning, Motivation and Constructivist Learning Environment *International Journal Of Environmental & Science Education*p3117-3137
[7] Davenport *et al*2016 Evidence-Based Approaches to Improving Chemical Equilibrium Instruction *Journal of Chemical Education*
[8] Demircioglu G, Demircioglu H and Yadigaroglu M 2013 An Investigation of Chemistry Student Teachers' Understanding of Chemical Equilibrium *Journal on New Trends in Education and Their Implications*
[9] Demircioglu G, Demircioglu H and Yadigaroglu M 2013 An Investigation of Chemistry Student Teachers' Understanding of Chemical Equilibrium *Journal on New Trends in Education and Their Implications*
[10] Yildirim N, Ayas A and Kucuk M 2013 A comparison of effectiveness of analogy-based and laboratory-based instructions on students' achievement in chemical equilibrium *Journal of Education* Vol. 2(6), pp. 63-76
[11] Suryadi D 2010 Didactical Design Researchdalam Pengembangan Pembelajaran Matematika *Makalah Seminar Nasional Pembelajaran MIPA di UM Malang*
[12] Sato M 2014 *Mereformasi Sekolah "Konsep dan Praktek Komunitas Belajar"*