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PREPARATION OF REFLECTIVE PEDAGOGY PARADIGM LEARNING FOR THE LECTURERS BASED ON COMPUTATIONAL CHEMISTRY

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Abstract

The study aim to prepare lecturers on reflective pedagogy paradigm (RPP). This research was mixed methods. It was conducted with 9 students and a model lecturer (mantee) who underwent mentoring. It was held in 4 meetings and observed by 2 observers. The assessment was conducted using data triangulation to a model lecturer based on: video recording, reflection by mantee and students. The measure of process success was based on video recordings by ≥70%. The lecturer's reflection to demonstrate the readiness in the teaching, and the student's reflection is ≥ 60%. The results of mantee and student at every stage are: 81%, 69%, 88%, and 50%; 72%, 92%, 73%, and 85% of context, experience, reflection, and action. The results of evaluation there was a significant difference before and after the learning based on *RPP ($p = 0.035$)*. So, mentees was able to manage RPP and able to make students active to learn from theory to practice.

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INTRODUCTION

The development of time and technology today in education provides a change in education, which is a change in paradigm from teacher-centered learning to student-centered learning (Asoodeh et al.,2012; Marioara, 2015). It requires teachers or lecturers to play a very important role in maximizing their competence in classroom management and provide learners with more learning possibilities (Wang, 2014). In the learning of chemistry education at University of Muhammadiyah Semarang, it has the problems in the course of organic chemistry. Organic chemistry is a subject with vast scope materials and tends to be memorized only by the students. The application of organic chemistry in the chemistry education in Semarang is still very little. It is certainly necessary to make a change in order to improve the overall quality of learning not only from the quality of the test results but also overall improvement of learning process. And learning activity efficiency can be achieved operating with student-oriented educational strategies (Viorica, 2015).

Based on the internal reflection conducted by the lecturers, the information was obtained that the quality of teaching was unsatisfactory. Such reflections included "What has been gained from the learning process?"," What is the value obtained when the process takes place?" and "What to do next (implementation)?". The results were not satisfactory due to the limited ability of the lecturers in the mastery of learning process (method) and the ability of the supporting facilities for the learning materials of organic chemistry. The efforts that will be made is to improve the teaching methods and learning materials of organic chemistry. The learning paradigm chosen was Reflective Pedagogy Paradigm (RPP) and the supporting material used was the software of Marvin.

Reflective Pedagogy Paradigm (RPP) had been chosen since it was proven to improve the performance of lecturers in teaching, to enhance the readiness of lecturers in teaching, to makes students able to reflect on learning processes, to make students more active (Wijoyo, 2016). Lecturers require a special training in order to implement the RPP, particularly on the teaching strategies based on Reflective Pedagogy Paradigm and reflection skills (Wijoyo,2016; ICAJE, 1993; Gwaza et al.,2010; Schaub-de Jong et al., 2011).

The RPP implementation efforts in Chemistry Education Program will be focused on improving the quality of learning and the student's ability to use computational chemistry software as a support in the course of organic chemistry.

Based on the research results, the computational chemistry software of Web MO & Gaussian 09 integrated in the curriculum could improve the students' understanding in their experimental works throughout the semester (Brian & Nicholas, 2016).

In addition, the application of some computing software that could deepen the computing capability was, for example, Marvin Sketch of Chemaxon.

The expectations of the research was that the improvements will be obtained in the quality of learning that will improve student's competence. Therefore, the lecturers of organic chemistry at the Study Program of Chemistry Education at the University of Muhammadiyah Semarang highly need the training to apply the RPP undertaken collaboratively among the lecturers and completed by the application of computational chemistry software in order to improve the professionalism of the lecturers teaching in the classrooms.

METHODS

This research was conducted with the involvement of one lecturer and nine students of the chemistry education. This research was mixed methods. The implementation of the RPP was conducted in the course of organic chemistry in the study program of chemistry education which was conducted in four meetings. The stages of the research were conducted in the following orders:

1. Module and instrument development

a. Preparing the RPP-based learning plan, learning modules, and case studies followed by validation by experts;
b. Preparing the reflection journals for students and instrument validation by experts;
c. Preparing the reflection journals for lecturers and instrument validation by experts;
d. Preparing the guidelines for lecturer mentoring along with the assessment instruments, and instrument validation by experts.

2. Choosing a model lecturer for implementing the learning in the classrooms based on the plans that had been prepared, while the other lecturers were appointed as the observers to observe the learning activities including all kinds of attitudes shown by the students during the lesson.
3. Analysis
   The assessment was conducted in triangulation to the lecturers who underwent mentoring process based on: (1) video recording, (2) the lecturer's personal reflection, and (3) the students' reflection journal. The assessment was made quantitatively and qualitatively. Lecturer mentoring participants were selected based on predetermined criteria. The mentoring activities were carried out four times with different materials.

Data collection and analysis were conducted in the following ways: the assessment to the video recording was made quantitatively and qualitatively; mentee's personal reflection is a qualitative data to strengthen the assessment of video recordings, and the assessment to the students' reflection was made quantitatively and qualitatively. The measure for success was as follows: the value of video recording with the total value ≥ 70%; the value of the lecturer's personal reflection in the form of descriptive data to demonstrate the readiness of the lecturers in the process of teaching from time to time; the students' reflection journal with the total value of ≥ 60%.

RESULTS AND DISCUSSION

The development of learning tools has been prepared based on several provisions that have been agreed upon in the course of organic chemistry. The Learning Outcome (LO) is that the students were capable in a systematic, logical, creative, and skilled way in drawing and synthesizing carboxylic acids and their derivatives; they became honest, conscientious, caring and involved in the education on the use and danger of carboxylic acids and their derivatives in the community. The typical thing was that, in LO, it carried out a more detailed elaboration into competence, conscience, and compassion, known as 3C. The elaboration into 3C became a hallmark of the RPP-based learning.

Furthermore, the instructional materials that will be used as a reference of material delivery on the activities of Reflective Pedagogy Paradigm were designed. In this study, the model lecturers used in the study was Eko Yuliyanto, while the observation process was made by recording the learning process. In the process of learning, the software of Marvin Sketch 17.01.30. In the learning process, the learning media in the form of power point and the learning modules of organic chemistry based on Mavin Sketch was prepared.

Figure 1. the Software of Marvin Sketch Version 17.1.30

Figure 2. Textbook of Organic Chemistry

The materials used were carboxylic acid and its derivatives. The design of the Learning Process was designed for 4 meetings. In addition, the learning process also delivered a scientific practice of using the software of Marvin Sketch. They were summarized in one book. The learning process began when all instruments existed. The model lecturers made the learning process and the results of the lecturer's mentoring during 4 meetings are presented in Table 1.

Table 1. Results of lecturer's mentoring in organic chemistry learning

Meeting	Context	Experience	Reflection	Action
1	4	2	3	2
2	3	2	3	2
3	3	3	4	2
4	3	4	4	2
Means	3.25	2.75	3.5	2
		Pre-test = 26.50		
		Post test = 36.27		
		p=0.035		

In Reflective Pedagogy Paradigm, every learning process consists of several stages of context, experience, reflection, action, and evaluation. The results of model lecturer mentoring can be described as follows.

In the stage of contexts, the lecturers made preparations to teach well as seen from the advance organizer which had been made, such as delivering the purpose of the course and giving a vivid description of its application in public about the products that contain carboxylic acid and its derivatives.

The lecturers also always repeat the topics that had been discussed at a previous meeting, and collect students' homework. Context was conducted to explore the student's prior knowledge. There are several ways to get the prior knowledge of the students; one of them would be better by means of quiz or discussion. In learning, the lecturers conducted apperception and small discussion about the materials to be covered. They are surely the matters that attract students in everyday life, for example, in the form of a conflict of chemical use.

At the stage of experience, during four meetings, it seemed that the lecturers were getting better at managing the stages of experience in the PPR and getting the maximum value at the last meeting. At this stage, the lecturers enabled students to use the method of Cased-Based Learning (CBL). The process was proven to be effective in engaging the students through independent study (drawing a chemical structure using the software of Marvin Sketch), active discussion between the students and lecturers, dialogue between the students and lecturers, providing feedback among students. It was found that in the meetings the liveliness and confidence of the students increased. It was seen by the increasing number of students who dared to appear in front of the class to work on the problems or present the results of their group discussions.

It is quite disturbing that at three initial meetings the lecturer sometimes forgot to take students conclude the lecture, but it was improved in the last meeting. Here, the opinion of assessors at the video of the 4th meeting on the stage of experience was delivered:

> *The lecturers taught using power point (which had been prepared very well). The students were actively involved through: (1) the making of questions and drawing chemical compounds on the whiteboard, and (2) active discussion. (This process was better than the previous meeting which was merely questions. However, in the active discussion, question and answer was held and the students were able to argue; the students were also more confident in working in the class). Students worked on the problems of CBL in group. The lecturers walked around from one group to another group and held a discussion in the small groups. The students presented their group discussion results in front of the class. The lecturers also directly discussed the solution to problems which were done by the students. The process of active discussion between the lecturers and students worked well at this stage.*

At the stage of reflection, the lecturers gave a description on the way how to write a reflection to students properly, started from providing reflection sheets, and taught the way how to write them.

At the third meeting, the example of writing a good reflection by the students had also been conducted. Starting from the third meeting, the lecturers explained the reflection writing to the students in detail.

In stage of Action, the lecturers always motivated the students to be able to apply the chemistry science in the community in need. Even, at the third meeting, when working on the CBL questions, the prospect of the entrepreneurship in carboxylic acid was written. These efforts were very much appreciated because it opened up the students' horizons not only to understand the materials, but also the development soft skills. The lecturers also provided follow-up to the students for homework. The results of the observations were not identified; whether the lecturers gave the consultation time out of lecture or not.

However, based on the reflection of model lecturers, the lecturers always gave time to the students who wanted to share or consult on the course of organic chemistry.

> *The lecturers had motivated the students to dare to apply their knowledge in the community. The lecturers had given the task of follow-up to the students to synthesize methyl salicylate: tool materials, the reaction mechanism using the software of marvin, and the price of the materials*

At the stage of evaluation, the evaluation was made at an early stage (pre-test) and final stage (post-test). The students followed the evaluation, and the score of pre-test is 26.5 and the score of post-test is 36.37. Based on the statistical tests, the significant results were obtained ($p = 0.035$). The results indicate an increase in the students' knowledge on organic chemical materials after following all PPR-based learning processes fully. However, the values are not entirely satisfactory as stated by the lecturers below. The other conditions that occurred during the research process were expressed by the lecturers of the course of organic chemistry.

> "We *realize that our students have standard input and added by the condition of the research process during the density of student activities with extracurricular activities on campus. Nearly 90% of our students join 2-3 extracurricular so that the physical condition factors also affected the current state of learning. As a result, their learning concentration was disrupted, and the results of cognitive evaluation have not been significant*"

In the learning process, the researchers also measured the students' reflection after participating in the learning process of organic chemistry. The assessment results of the students' reflection by the designated observers are as follows:

Table 2. Students' Reflection Results

Meeting	Q1	Q2	Q3	Q4	Mean of Q
1 (n=9)	2.67	2.67	3.60	2.67	2.89
2 (n=9)	3.83	3.33	4.00	3.61	3.69
3 (n=9)	3.52	2.94	3.29	1.94	2.92
4 (n=9)	3.09	3.22	3.93	3.39	3.40
Means of reflection	3.28	3.04	3.70	2.90	

Question 1. The students were quite capable of writing the learning process in detail and linked it with the purpose and relevance of the course after they graduated. One example of the reflections is as follows:

> *My initial goal was to be able and well-informed about organic chemistry and to get valuable experiences. The objectives had been achieved. The learning was very influential when I became a teacher. This learning can be applied in their daily lives, not only in formal education, but it can also be applied in non-formal education.*

Question 2. The students were quite capable of writing the knowledge they had acquired, but they had not been able to write down the values they acquired during the learning. The following is the example of their knowledge absorption capability:

> *Knowing various acidic compounds, such as vinegar which is on our side when eating chicken noodle etc. I understand the content of vinegar in the cause of vinegar acid and its drawbacks as well as writing the compound trivially or in IUPAC either through writing or using a computer.*

Question 3. The students were able to develop *soft skills* during the learning process, such as willing to listen to others, having the courage to express opinions, respecting the opinions of others, willing to work in teams, being honest,

responsible, self-discipline, and having good time management, having politeness and helping others. The *soft skills* were perceived by them dominantly when following the study.

Question 4. The students had the initial intention to take action for the implementation of their course after completion of the course or after they graduated. One example of a good action plan of the students is:

> *I am increasingly aware of the material of carboxylic acids and their derivatives. I will deliver and pass on the knowledge to my students later because I am as a candidate for a chemical educator and want to be an entrepreneur relating to carboxylic acids and their derivatives.*

DISCUSSION

Through mentoring, the *mentees* actually went through the process of internalization of the RPP; reflection-action experience, the *mentees* conducted teaching activities (the stage of experience), and they reflected on it personally added with the support of the assessment results to their performance during the teaching and reflection journal (the stage of reflection) as well as making the improvements in the previous meeting on the recommendations obtained from the assessor (the stage of action). The three important things were the main spirit of the RPP which were expected to be a way to act for the *mentees* in teaching (ICAJE, 1993).

The repair process of learning is not only centered on the teachers, but there are a lot of things to do. However, there are important things owned by a teacher who is doing the learning directly in the classroom. It is in line with the following statement. "*The most powerful, durable, and effective agents of educational change are not the policymakers, the curriculum developers or even the education authorities themselves; they are the teachers 6 (*Sellars, 2012*).*

Reflective Pedagogy Paradigm (RPP) was able to improve the performance of lecturers in teaching, to enhance the readiness of lecturers in teaching, to make the students able to reflect on the learning process and to be more active (Wijoyo, 2016).

It is in line with: Learning From Experience Is Enriched By Reflecting On Experience (Dewey, J., 1933). And Represents The Reflective Practice An Important Factor To Improve Professional Activity. Reflection Is A Central Role In Learning Because Through It We Become Aware Of The Ways In The Which We Interpret Reality And Give Meaning To The Actions And Behavior 9 (Mezirow, J., 1991; Mezirow, J., 2000).

The presence of several advantages of RPP requires the implementation of the RPP in the process of collaborative learning on organic chemistry to increase professionalism among lecturers in the classroom. In the RPP, the very striking piece is a reflection. Reflection is necessary to be understood by a lecturer. It is defined and interpreted by different academics and researchers differently. They all accept that it is a desirable attitude and practice to improve one's practice and learning (Gustafsson & Fagerberg, 2004). Without reflection, length of experience does not automatically give insight and wisdom and thus, one can run the risk of relying on routinized teaching and not developing (Loughran, 2005; Hopkins, 1999).

In addition, in learning process, sometimes we make mistakes, and it is not a disgrace. Not dirty linen to be kept from the public's view, but opportunities for dialogue, learning and change'.

The improvement to various mistakes performed during the learning process can be made as a discussion material to find the solutions. The presence of various problems can surely be made as a discussion material to improve the learning process. Loughran (2002) states that growth comes from a 'reconstruction of experience'. Therefore, experiential learning theory holds the idea that learning is dependent on the integration of experience with reflection. It puts reflection at the center of learning process. Based on this theory, it can be argued that by reflecting on their own experience, teachers as learners can construct their own educational perspectives and gain new insights from that experience and develop new strategies to use in subsequent teaching (Boud et al., 1985; Kolb, 1984).

Some other studies state that reflection is a good method to improve learning process. It is

in line with the following statement, "Reflection is a powerful procedure that teachers can utilize to investigate, and make their teaching practices better" (Fatemipour, 2013). Besides, individuals can show readiness for learning throughout their career (Rădulescu, 2013).

The learning process of Reflective Pedagogy Paradigm was held in several stages with the following discussion. In the stage of context, the activities of the *mentees* were in line with the research (Pennington, 2013, et.al) which says that teachers should provide a description of the purpose and stages of the learning process as well as explore *prior* students knowledge.

Similarly, it was also explained on the association of the materials with the employment world so that the students get the understanding on the importance of the course. It is in line with the ones stated by the researchers; learning situation should be put in the context of real situations (Hattie, & Visible, 2009; Mc Avoy, et al., 2012). So that students truly understand the objectives and outcomes of the learning process of the material. For example, the creation of conditions was made to start the learning of carboxylic acids and their derivatives. It was presented by the lecturers about acetic acid which is one of the ingredients used in the food "Chicken Noodle" in Indonesia at the stage of Context.

At the stage of **experience,** the students were invited to construct new knowledge by doing a comparison, contrast, evaluation, analysis, and synthesis of all the mental and psychomotor activities to understand the reality better. The activities undertaken were the activities which were able to integrate cognitive and affective aspects directly or indirectly (Rincon, 2007).

The presentation of the lecturers in the form of a combination *of power point* and playing the film/ animation was then followed by a group discussion; a process to improve the understanding on the lecture material. During the group discussions, the lecturer walked around from one group to another one to assist the ongoing discussions. The lecturer and student interaction process is known as *cura personalis*. Geger (2014) tated that *Cura personalis* is an active effort of lecturer to encourage student's potential to be more developed. At the stage of giving experience: the lecturer used the software of Marvin Sketch and provided the *Case-Based Learning* (CBL) to the students for discussion.

The next stage was the stage of **reflection.** Reflection is the heart of the RPP and a bridge between teaching and student's learning effectiveness (Rincon, 2007). As a means of reflection, a personal reflection journal was used. Reflective journal writing can be a means to promote one's inner dialogue, to foster inspiration and new ideas, to sharpen awareness, to manage emotions, to make learners to be active, to reach an enlightenment, to cultivate honesty of expression, and to train the ability to write (Moon, 2010; Aronson, 2010). (Wood, 2013) states that reflection makes students able to find a link between the knowledge learned with reality and its application in society. It is important that students have the interaction with the surrounding social environment.

The stage of **action** was carried out in three stages. The first stage was when a lecturer gave homework for the group of students and motivated the students to dare to apply their knowledge in the community. Metts (1991) said that homework is a process of reps (repetitions) which will strengthen students' understanding on the material. The homework given by the lecturer involved *higher order thinking* and imagination skills in the form of analysis and solution design of a case. The processes provided the foundation for the students' self-confidence and motivation to apply their knowledge in the community. The encouragement given by the lecturer at the end of the course could lead the students to realize the action plans which they wrote in their reflection journals. It is in line with the research results (Lo, 2014). Showing that motivation is very important to trigger the students' courage to apply their knowledge in the community. If the students follow the encouragement of the lecturer, the students will obtain a very rewarding experience to support their readiness after graduation as well as strengthening the understanding of the knowledge they acquired.

However, the performance of lecturers in the stage of action was still good considering the lecturers had not allocated time to provide

guidance to the students or groups of students to work on the assignments.

The evaluations were conducted periodically to encourage the lecturer and students to pay attention to intellectual growth, attitudes, and actions which are aligned with the principles of *men and women for and with others*. Based on the overall information above, there was a positive development in the mentee's performance in the implementation stage of the RPP. Based on the evaluation using MCQ, there is a significant difference before and after the RPP-based organic chemistry learning ($p = 0.035$).

Overview by reflection questions: Based on question 1 on the description of the learning process and achievement of objectives and relevance, it shows the mean of 3.28 indicating that the students were fully able to grasp the meaning and relevance of the learning process. For questions 2 and 3 on the knowledge and life values, the students could formulate their reflections adequately with the achievements of 3.04 and 3.70. (Colley et al., 2012) said that the writing of reflection strengthens the ability of critical thinking in students Writing reflection also strengthens the processes in cognitive systems, knows the knowledge obtained, and can identify the ultimate goal of learning process. For the 4th question, the value of reflection is 2.90 indicating that the students were quite capable of identifying the follow-up they would do after the course was completed, but they were not quite able to realistically declare in a realistic time frame.

The students could write down a plan of action well, and they were personally responsible to make decisions in the form of action plan based on the understanding of the learning experience obtained after a thorough consideration (Denk, 2006)

Overview by meeting: the students' reflection scores reviewed from each meeting were fluctuating. It is likely related to the psychological condition of students in following the study. Our students were active in several student organizations, so the fatigue factor can also be the cause. It made 100% of the students did not receive continuous exposure to the materials that affected on the way how to write the reflection. The lecturers who regularly read the reflections of the students got the constructive, realistic and honest feedbacks. Thus, the lecturers were able to make improvements to the learning process (ICAJE, 1993). Reading the reflection journals made the lecturers knew students personally through the development of the reflective writing. By getting to know the students, the principle of *cura personalis* was more easily carried out during the class (Lo, 2014).

Meanwhile, from the other review, it is the satisfaction of the students during the learning process. At the beginning of each meeting; Did the lecturers explain the content and purpose of the materials to be delivered? (88%), How was the lecturers' explanation in delivering the course materials? (72%) Did the lecturers give the students the opportunity to ask in each lecture? (74%).

Did the lecturers gave the examples of *up to date* cases in the lectures? (78%). They are in line with the conditions of the students' reflection results in the RPP.

CONCLUSION

From the final results of the study, it is concluded that:

(1) the mentees were able to manage RPP-based learning in the classroom;

(2) the mentees were able to enable students to study organic chemistry. The existing weakness was that the lecturers had not been able to generate the students in the stage of action to put into practice the materials that had been given outside the classroom or community;

3) the mentees had already been able to apply the teaching strategies based on Reflective Pedagogy Paradigm, so they can actually apply the real learning in the classroom.

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