Implementation of Self-Regulated Learning for Pharmacy Students in Nervous System Pharmaco Therapy

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***Abstract*—Background: Conventional learning through lecturing decreases students' involvement whereas students' active participation in class promises more benefits. The development of active learning method can help hone students' soft skills in thinking critically and systematically. This study aimed to identify the influence of self-regulated learning (SRL) on students' active participation and learning outcome in the Nervous System Pharmacotherapy subject. Students' response towards the self-regulated learning method would also be described. The study used a quasi-experimental quantitative approach with a non-equivalent control group design involving four classes of fifth-semester pharmacy students during December 2016. Students were divided into 2 control groups (155 students) and 2 intervention groups (124 students), which were then divided into 1 case group involving an international lecturer and SRL application as well as 1 case group involving an internal lecturer and SRL application. Learning outcome was assessed based on the average final score and pass rate of all students compared to the average final score of last year's students, while the active participation was graded from their ability to do a presentation. To identify students' response towards the learning process using SRL, a questionnaire adopted from other studies was utilized. There was an improvement in the average final score of all students of 2016/2017 as much as 70.94 compared to the average final score of all students of 2015/2016, which was 67.8. The evaluation on students' active participation showed a relatively satisfactory result with 7.25 average score in Case 1 Group and Case 2 Group and 6.99 in the Control Group. The students also indicated positive responses to the implementation of SRL method, reaching 81.3%. The implementation of self-regulated learning could improve students' active participation and learning outcome in Nervous System Pharmacotherapy.**

***Index Terms*—pharmacy, self-regulated learning, pharmacotherapy**

I. Introduction

The challenges faced by pharmacists as medical staff have been recently escalating. The paradigm of pharmacists' role has shifted from drug-oriented to patient-oriented demanding therefore adequate pharmaceutical knowledge and skills, including pharmaceutical care. The demand from the society and other medical staff for the role of pharmacists has significantly increased, particularly relating to the need for education and information about drug use in various diseases. One of the pharmaceutical sciences that support the competency of pharmacists in implementing pharmaceutical care is pharmacotherapy, which has been determined by the Indonesian Association of Colleges of Pharmacy (APFTI) and Indonesian Pharmacist Association (IAI) as a compulsory subject in the core curriculum of college of pharmacy and college of pharmacist.

To fulfil the requirements from APFTI and IAI as well as to produce pharmacy graduates and pharmacists who are excellent at providing pharmaceutical care, the curriculum of Pharmacy Department of UII has provided 14 credits of pharmacotherapy consisting of 5 subjects that are grouped based on disease cases and organ systems. Nervous System Pharmacotherapy (NSP) is part of the pharmacotherapy subjects taught as early as the 5th semester, and it also becomes the initial stage of "pharmacotherapy mindset" formation that combines the understanding of disease pathophysiology and clinical pharmacology of corresponding drugs. The formation of pharmacotherapy mindset is essential in this subject since it is the early part of pharmacology lecture series in the Pharmacy Department of UII.

In general, the learning outcomes of pharmacotherapy subjects in the Pharmacy Department of UII have yet to indicate a good profile. Considering its position as a competency compulsory subject and its large number of credits, low pharmacotherapy grades can strongly affect the achievement of timely graduation target. Therefore, various efforts have been made to achieve better learning outcomes and timely graduation target.

The NSP subject has 2 credits, and previous learning processes involved a lecturing method supported by *klasiber* UII (cyber class) for the repository. The assessment components consist of merely quizzes and exams. The efforts to improve the learning quality have been taken by using animation and videos in the lecture for several topics. The average final grade in 2015/2016

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reached 67.8 (B-). The final term exam results have been fairly good with 64.2 average exam score, but the average midterm exam score was only 58.7. The characteristics of final exam questions dominantly tested students' memory, while the midterm exam questions mostly examined students' ability to handle cases in hospital.

An identification of student conditions indicated that a) Not all students had a goal setting for pharmacotherapy, which therefore affected the score of pharmacotherapy subjects, including NSP; b) Students had yet to be highly motivated to learn pharmacotherapy because they lacked understanding of the application and benefit of pharmacotherapy in the practice of pharmaceutical care, which was shown by their passive participation during the learning process; c) Students had inadequate learning strategies to master pharmacotherapy that requires the ability to memorize, analyze, synthesize, and evaluate, which is supported by the ability to make reliable recommendation with confidence.

These student conditions highlighted the need for improvement of teaching methods that can develop students' ability to participate more actively in the learning process and make students become independent learners who are able to manage the learning process effectively without strong dependence on others. One of the characteristics of independent learners is the ability to formulate learning strategies and to create conducive learning environment using available resources and skills.

A learning method well-known for its effectiveness in producing independent learners is self-regulated learning (SRL), which has also been acknowledged as an important fundamental method in the implementation of various student-centred learning methods, including problem-based learning [1]. The ability to self-regulate the learning is psychological in nature and not an individual talent; therefore, it can be well developed through a continuous practice. In addition, students' learning ability can improve when relevant learning activities are conducted. The selection of appropriate teaching methods that make it possible for students to be independent learners is necessary to implement [2].

Also, motivation is one of the most important aspects to own by a person to become a self-regulated learner [1], [3]. Motivation can be established through reinforcement of intrinsic motivation encouraged by a clear strong goal-setting, which is then strengthened by extrinsic motivation using various methods, including a role model. High motivation will encourage students to formulate their learning strategies and create the best learning condition to achieve the target outcome [3]. This study therefore aimed to describe the implementation of self-regulated learning (SRL) method in Nervous System Pharmacotherapy, identify the influence of SRL on students' active participation and learning outcome, and describe students' response towards SRL.

II. Research Method

This study used the quasi-experimental quantitative approach with non-equivalent control group design. It was conducted during December 2016 by involving four classes of Pharmacy students in the 5th semester. The research procedure included the stages of preparation, implementation, and evaluation.

A. Preparation Stage

It is the initial activities conducted in the first meeting of the lecture, including:

Adjustment of Course Outline and Lesson Plan for the case groups by including general SRL aspects and guideline for the morals of learning based on Al-Qur'an and Hadiths

Questionnaire design for identifying students' condition relating to several SRL aspects

Procurement of relevant references to support SRL implementation and NSP materials

Preparation of motivational materials in the form of quotes, videos, or verses of Al-Qur'an and Hadiths

Design of learning materials that consist of material presentation and handout, preparation of evaluation tools including quizzes and exams, as well as design of independent assignment that supports optimum implementation of SRL for students

Upload of all the prepared materials in the system of *klasiber* UII (online class)

B. Implementation Stage

SRL was implemented a case-control design by dividing students into three groups as follows:

Case 1 Group: a group of students involved in the implementation of SRL by inviting an international lecturer during the learning process of one class

Case 2 Group: a group of students involved in the implementation of SRL without inviting an international lecturer during the learning process of one class

Control Group: a group of students without SRL implementation consisting of two classes

Since the SRL implementation would affect students' final grade, their participation as respondents was voluntary. The researcher informed each student about the implementation of SRL, and they were allowed to choose which group to be involved in.

Case 1 Group

In the first meeting, students were asked to set a goal of learning process and discuss the courtesy and morals of learning based on Al-Qur'an and Hadiths. Students were also encouraged to grow their learning motivation through several prepared quotes and videos. Then, students were invited to formulate effective SRL strategies to achieve their set goals. For this Case 1 Group, it was specially informed that there would be a lecture from an international lecturer, and they were invited to make thorough preparation.

In 2nd – 7th meeting, the lecture was conducted using the usual methods, such as lecturing, discussion, and assignment for individuals or groups as well as evaluation through quizzes while continuously maintaining student motivation.

The 9th – 13th meetings were taught by an international lecturer from the University of Wolverhampton. Besides lecturing on the materials from the lesson plan, the

lecturer also provided a description of NSP applications and the role of pharmacists in handling psychiatric diseases as well as motivated students and boosted their self-efficacy relating to the opportunity for pharmacists to contribute to health services nationally and globally. For Case 2 Group, the same materials and methods would be implemented without involving the international lecturer.

Evaluation of learning process was conducted through assessment of learning outcome and effectiveness of learning process. The evaluation of learning outcome would be based on quizzes, assignments, and exams including midterm exam and final term exam.

Case 2 Group

The 1st meeting was used for goal setting and discuss the courtesy and morals of learning based on Al-Qur'an and Hadiths. Students were also encouraged to grow their learning motivation through several prepared quotes and videos. Then, students were invited to formulate effective SRL strategies to achieve their set goals. For Case 1 Group, it was specially informed that there would be a lecture from an international lecturer, and they were invited to make thorough preparation.

In 2nd – 7th meeting, the lecture was conducted using the usual methods, such as speech, discussion, and assignment for individuals or groups as well as evaluation through quizzes while continuously maintaining student motivation.

The 9th – 13th meetings were used to implement SRL by an internal lecturer (the researcher). One week prior to the meeting, the students were given a group worksheet to discuss, and in 1st meeting the groups would present the results of their discussion. The lecturer would provide feedback and help explain material inappropriateness or discrepancy.

Evaluation of learning outcome was done through quizzes, assignments, and midterm as well as final term exams.

Control Group

All the learning process used the lecturing and discussion methods.

C. *Evaluation Stage*

Evaluation of the learning grant would be conducted on several aspects, including learning outcome, process of grant project implementation, and impacts that required follow-up for upcoming activities. Evaluation of the learning outcome would be based on the success of targeted average score and final score of Nervous System Pharmacotherapy subject. Evaluation of the learning process and impacts of grant project was conducted by measuring the achievement of several indicators that describe the quality and results of project implementation quantitatively and qualitatively. The performance indicators to evaluate the effectiveness of grant implementation are described in Table I.

TABLE I. PERFORMANCE INDICATORS OF LEARNING GRANT IMPLEMENTATION

No.	Indicator	Baseline	Target
1	Average final score of Nervous System Pharmacotherapy subject	67.8	≥ 70
2	Availability of Course Outline and Lesson Plan of Nervous System Pharmacotherapy that accommodates SRL implementation	Unavailable	Course Outline and Lesson Plan of Nervous System Pharmacotherapy that accommodates SRL implementation are available.
3	Availability of Nervous System Pharmacotherapy handouts	Unavailable	Nervous System Pharmacotherapy handouts are available.
4	Students' level of satisfaction of the overall learning process	Unavailable	≥ 80% students are satisfied with SRL implementation.
5	Availability of implementation concept for a learning process that involves international lecturers	Unavailable	Implementation concept for a learning process involving international lecturers is available.

III. RESULTS

A. *Students' Learning Outcome*

Effectiveness of SRL implementation is observed from the improvement of students' learning outcome. The improvement is reflected by the increase in the average score that reached 67.8 with more than 90% pass rate. The marking components of Nervous System Pharmacotherapy using SRL method include assessment of soft skills and hard skills. The soft skill assessment includes presentation score weighing 10% of final grade. Meanwhile, the assessment of all performance indicators of learning grant is described as follows.

Average final score

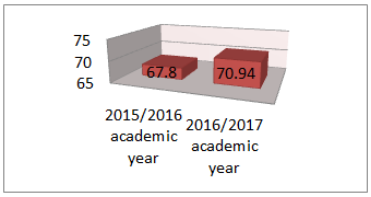

Figure 1. Comparison of average final score of nervous system pharmacotherapy subject between 2015/2016 and 2016/2017 academic year

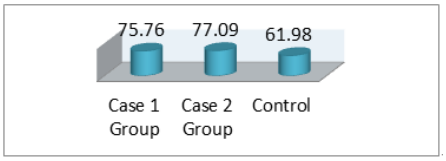

Figure 2. Comparison of average final score of nervous system pharmacotherapy subject among the classes in 2016/2017 academic year

Note:

Case 1 Group: Class with SRL implementation and international lecturer

Case 2 Group: Class with SRL implementation and internal lecturer

Control Group: Class without treatment

The hypothesis testing using one-way ANOVA showed that the average final scores of the three groups were significantly different ($p<0.0001$). From the post-hoc analysis, it was found that the case groups were significantly different from the control group, while Case 1 Group was not significantly different from Case 2 Group ($p=0.065$)

Average Final Term Exam Score

The comparison of average final term exam scores between 2015/2016 and 2016/2017 as well as the comparison between case and control groups are presented in Table IV and Table V.

TABLE II. COMPARISON OF AVERAGE FINAL TERM EXAM SCORES OF NERVOUS SYSTEM PHARMACOTHERAPY BETWEEN 2015/2016 AND 2016/2017 ACADEMIC YEAR

Academic Year	Average Final Term Exam Score		Mean Difference
	2015/2016	2016/2017	
	58.70	64.19	5.49

Table III showed that average final term exam score in 2016/2017 academic year slightly increase compare to the previous year.

TABLE III. COMPARISON OF AVERAGE FINAL TERM EXAM SCORES OF NERVOUS SYSTEM PHARMACOTHERAPY BETWEEN CASE GROUPS AND CONTROL GROUP

Group	Average Final Term Exam Score		
	Case 1	Case 2	Control
	48.16	80.38	64,01

Note:

Case 1 Group: Class with SRL implementation and international lecturer

Case 2 Group: Class with SRL implementation and internal lecturer

Control Group: Class without treatment

Table III showed that average final term exam score on case 2 group, class with SRL implementation and internal lecturer got the highest score compare to case 1 group and control group. The lowest score is shown in the case 1 group, class with SRL implementation and international lecturer. According to interview with students, the students expressed difficulty understanding the material in English. Nevertheless, students feel motivated to learn the lecture material in English.

TABLE IV. COMPARISON OF AVERAGE MIDTERM EXAM SCORE AND AVERAGE FINAL TERM EXAM SCORE OF NERVOUS SYSTEM PHARMACOTHERAPY SUBJECT BETWEEN CASE GROUPS AND CONTROL GROUP

Average Score	Case 1		Case 2		Control	
	Mid	Final	Mid	Final	Mid	Final
	68.75	48.16	68.47	80.38	57.06	64.01

Note:

Case 1 Group: Class with SRL implementation and international lecturer

Case 2 Group: Class with SRL implementation and internal lecturer

Control Group: Class without treatment

Pass Rate of Nervous System Pharmacotherapy Subject

Table IV showed that average final term score in case 1 group slightly decreased compare to average midterm exam score, however in case 2 group showed increasing on average final term score than average midterm exam score.

TABLE V. COMPARISON OF THE PASS RATE OF NERVOUS SYSTEM PHARMACOTHERAPY SUBJECT BETWEEN 2015/2016 AND 2016/2017 ACADEMIC YEAR

Academic Year	Pass Rate	
	2015/2016	2016/2017
	81.6%	80.86%

TABLE VI. COMPARISON OF PASS RATE OF NERVOUS SYSTEM PHARMACOTHERAPY SUBJECT BETWEEN CASE GROUPS AND CONTROL GROUP

Pass Rate	Case 1	Case 2	Control
	94.4%	98.6%	76.31%

Note:

Case 1 Group: Class with SRL implementation and international lecturer

Case 2 Group: Class with SRL implementation and internal lecturer

Control Group: Class without treatment

Table IV showed that the pass rate in 2016/2017 academic year slightly decreased compared to the previous year, but the pass rate in SRL classes of both Case 1 and Case 2 was higher than that of the Control Group. This indicates that SRL gave a positive impact on students' learning process.

B. Active Participation

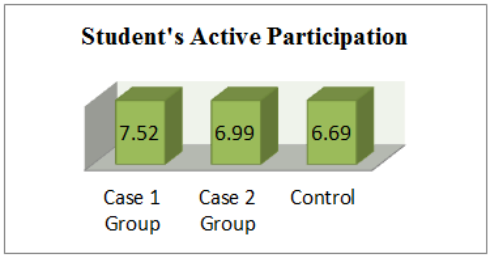

Figure 3. Score of Students' Active Participation in Nervous System Pharmacotherapy Subject

C. Level of Satisfaction

The result of questionnaire on students' level of satisfaction towards the overall learning process reached 50% because students were not yet familiar with SRL method, forcing them to adapt themselves. However, 81.3% students said they would apply the method in their upcoming subjects. SRL can be successfully implemented through a regular practice and relevant activities because SRL ability is psychological.

IV. Discussion

Student achievement is influenced by not only internal but also external factors. The implementation of a learning model with student active learning design is more effective than discussion and lecturing to increase student achievement [3]. One of the methods proven to be successful in improving academic achievement and forming independent learners is the self-regulated learning (SRL) method. A research mentioned that SRL gives a positive contribution to learners because it can improve their learning ability through self-motivation and self-efficacy. Learners proactively select the structure and create learning environment that includes physical and non-physical aspects that are beneficial for achieving their learning goals, and learners can play a significant role in selecting the learning types and activities tailored to their own individual requirements [1], [3].

Self-regulated learning (SRL) is a learning method that allows learners to effectively manage their own learning process independently by mobilizing all of their abilities and resources to achieve optimum outcome [4]. SRL is an active process that directs the learning objectives, controls the learning process, grows self-motivation and self-efficacy, as well as allows learners to select and manage the learning environment to support the learning process.

The implementation of SRL is based on the concept of constructivism that drives a learning process to be designed and managed accordingly in order to facilitate learners in organizing their learning experience to become meaningful new insights. In this learning process, learners not only receive what the teacher presents them but also establish new connections from the concepts and principles that they have learned based on the prior knowledge. In this model, learners are encouraged to be able to formulate the best methods and conditions for their own learning. The five essential aspects of SRL include: 1) setting the learning goal and target, 2) preparing the learning environment, 3) organizing the materials, 4) self-monitoring the progress, and 5) evaluating the performance.

The application of SRL usually comprises three phases: planning, performance, and self-reflection. In the planning phase, learners set their learning goal and target as well as plan their learning activities to achieve the defined goal and target. The performance phase is when the designed plans are implemented by involving the process of thinking and acting proactively to solve problems and develop knowledge during the learning process. This phase also involves the establishment of learning strategies, atmosphere and conducive environment to achieve the set goal and target. The third phase is self-reflection though self-assessment. Self-assessment is a process of comparing the performance results with the set goal and target. Self-reflection or self-assessment is one of the important parts and excellences of SRL. The control and reflection towards all the cognitive processes will encourage learners to discover by themselves the concepts given during the learning process and to understand their meanings more deeply. This will lead to learners' understanding of the target materials.

SRL has proved to give positive contribution to learners [3] in the following ways:

Learners can personally improve their learning ability through self-motivation and self-efficacy.

Learners can proactively select the structure and create the learning environment that includes beneficial physical and non-physical aspects to achieve their learning goals.

Learners can play a significant role in selecting the learning formats and activities accordingly.

Having intelligence and talent potential is inadequate to achieve success in learning. Psycho-educative drive is essential for developing this potential to achieve success in a process of learning [1]. Motivation and self-efficacy are among the important aspects that have to be developed to optimize learning outcomes. SRL emphasizes the development of self-motivation in learners. Motivation is divided into two categories: intrinsic motivation and extrinsic motivation [1]. Intrinsic motivation comes from within an individual without any force or support from others since it is based on a person's will. Meanwhile, extrinsic motivation appears as a result of influences from outside an individual, be it due to encouragement, invitation, order, or good news from others that persuade learners to do or learn a thing.

Self-efficacy is to believe in a person's self to be able to achieve the learning target and goal [1]. It is also defined as confidence in the ability to complete a given task. The more learners believe in their own ability, the more they will be firm to survive the path to their learning goals. Learners who believe that they have the ability will choose to do a task while those who are not confident in themselves will not [4]. Self-efficacy encourages learners' optimum achievement in the learning process. The main factors of self-efficacy are: 1) learning experience, 2) feedback from others, and 3) self-involvement in the learning process [4]. According to the results of research indicate that the effectiveness of student learning outcomes are also influenced by psychological factors of students, lecturers who teach but in this study the assessment of psychological factors and lecturers character is not done [5].

The average final score of Nervous System Pharmacotherapy subject was obtained from midterm exam score weighed 30%, final term exam score weighed 30%, quizzes weighed 20%, presentation weighed 10%, and assignments weighed 10%. In the previous period, the average final score of this subject was 67.8, while in the recent period it is 70.94 ± 11.05. Therefore, the average final score of students taking Nervous System Pharmacotherapy has qualitatively improved (Fig. 1).

According to Table 1 and 2, the average final term exam score of Case 2 Group was the highest, reaching 80.38, compared to that of Case 1 Group and Control Group. The Case 1 Group had the lowest score probably because the materials and exam questions were delivered

in English. Most of the students admitted that they had a problem understanding the materials given by the international lecturer.

Assessment of students' active participation used the presentation score with a scale between 0 and 10 and categories of Poor (0-4), Average (5-7), and Good (8-10). Fig. 3 indicated that Case 1 Group and Case 2 Group had better scores of active participation than the Control Group with 7.25 average score.

In this study, several problems were found in the class with international lecturer, particularly the language barrier. Most of the students could not quickly understand the materials delivered in English. The solution was done by recording the lecturer's voice when delivering the materials and the students discussed the lecture through Google classroom. Also, the available audio facility was inadequate (frequently lost sound) while the SRL required good audio to play a lot of motivational videos. The solution was then done when the researcher bought better loudspeakers. Another problem was related to the lecture hall that was quite small for about 70 students, making the lecture and discussion less effective, particularly when the international lecturer preferred walking around the room. To resolve this matter, several rooms were borrowed including the auditorium and library of the Faculty of Mathematics and Natural Sciences.

The lessons learnt from this grant implementation are that students are encouraged to continue their study overseas and motivated to improve their English proficiency. For the internal lecturer, this grant has motivated the lecturer to improve international collaboration and open more opportunities for cooperation in such programs as summer class, student exchange, joint publication, and doctoral program. Meanwhile, the impacts of the grant implementation on the learning process of related subject as well as other subjects in general in the department are that the international lecturer recommended some relevant references that students could use to study, the exercises provided by the international lecturer were more varied, the lecturer also described the work of a clinical pharmacist in Australia and England that is quite different from those in Indonesia, and students learned that it is important to have good English proficiency, and they were encouraged to learn English better.

V. Conclusion

Self-regulated learning can improve students active participation and learning outcome in the Nerve System Pharmacotherapy subject.

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