

The Implementation of a Case-based Learning Method on Physical Pharmacy Course

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ABSTRACT

This article reports on active learning techniques applied to the Physical Pharmacy course taught to the third-semester students of the Undergraduate Pharmacy Study Program, with a total class of 145 students divided into two parallel classes. The purpose of this action research is to develop a Case-Based Method in the teaching and learning process of Physical Pharmacy courses in accordance with the key performance indicators of the Ministry of Education, Culture, Research, and Technology. Learning guidelines are prepared, and the method is implemented in the Odd Semester of the 2021/2022 academic year. There were 3 cases presented to students during seven synchronous meetings before the midterms, which were discussed in small groups of 7 to 8 students. The outputs are in the form of mid-semester test scores and case completion scores. There is an increase in the average score of the students' midterm exams from (52.39 ± 14.47; n=71) for Class A; (57.78 ± 16.44; n=72) for Class B in the odd semester academic year 2020/2021 to (71.69 ± 11.38; n=67) for Class A; (69.40 ± 13.63; n=78) for Class B in the odd semester academic year 2021/2022. The survey of student satisfaction with the learning method showed an average score of 3.03 ± 0.28 (n=109) out of 4. The implementation of case-based learning methods in Physical Pharmacy course can add insight to students in applying the theory of physicochemical properties of drugs in designing drug dosage forms.

Keywords: "Action Research", "Physical Pharmacy Courses", "Case-based method", "Undergraduate Pharmacy".

1. INTRODUCTION

One of the competencies of Undergraduate Pharmacy Study program graduates is being able to design drug dosage forms and guarantee the quality of the products they produce. Therefore, knowledge of the physicochemical properties of medicinal raw materials and excipients is critical to achieving these competencies. In selecting prospective drug raw materials, a Pharmacy graduate should be competent in physicochemical properties and modify their unfavorable properties to meet the requirements of promising drug candidates [1].

The Physical Pharmacy course contains material that introduces students to the physicochemical properties of drugs. According to the Indonesian Association of Pharmacy Higher Education (APTFI), this course is compulsory in the undergraduate pharmacy curriculum [2]. Lecture materials are planned and arranged in such a way as to achieve the essential competencies that a Pharmacy graduate must possess in designing dosage forms, evaluating formulations, and improving the

bioavailability of dosage forms. Thus, pharmacy graduates can develop drug products that are guaranteed safety and effectiveness.

Lectures during the COVID-19 pandemic have taken place synchronously online. But there are limitations in interacting with students in large classes, especially in building student engagement during video conferences. Furthermore, the key performance indicators of higher education institutions from the Ministry of Education, Culture, Research, and Technology encourage the implementation of case-based and project-based learning methods in courses. The goal of this policy is that students are trained and have high-level thinking skills to solve problems when they graduate [3].

The case-based learning method is suitable for physical pharmacy courses (2 credit hours) delivered to 3rd-semester students of Universitas Andalas Undergraduate Pharmacy Study Program. At the beginning of the COVID-19 pandemic, this course was delivered using conventional learning methods

synchronously for 40 minutes and self-directed learning asynchronously for the remaining 60 minutes. During the videoconferencing, lecturers have difficulty inviting students to participate in class discussions and having them ask questions or comments during synchronous meetings. This lack of student engagement may be due to limited time; some students do not read the teaching materials that have been shared in the Learning Management System (ilearn.unand.ac.id), or students do not know what to ask [4].

In case-based learning, students are guided through analyzing cases to practice critical thinking and problem-solving skills. Students will look for related teaching materials and discuss in small groups to solve cases [5]. With this approach, students are expected to do self-directed learning asynchronously and actively participate in group discussions through video conference with a group. Thus students already know the topic being studied so that the 40-minute video conferencing can be used efficiently to ask questions and present the results of group discussions.

The purpose of this action research is to develop a Case-Based Method in the teaching and learning process of Physical Pharmacy courses and to evaluate the output and student's satisfaction on the new learning following the key performance indicators of the Ministry of Education, Culture, Research, and Technology.

2. METHODOLOGY

2.1. Sample

The case-based learning method was implemented to 145 students enrolled in Physical Pharmacy course in the 3rd-semester Undergraduate Pharmacy Study Program, Faculty of Pharmacy, Universitas Andalas, academic year 2021/2022. They were divided into two parallel classes; A(67 students) and B (78 students).

2.2. Procedures

The course lesson plan was improved from the conventional method to case-based learning. The new learning and teaching method was implemented in the odd semester of the 2021/2022 academic year. The lecturer explained the semester learning plan and the stages students would take in case-based learning at the first meeting. The stages are called the seven jumps technique which consisted of 1) clarifying unfamiliar terms, 2) defining the problem, 3) brainstorming possible hypothesis or explanation, 4) arranging explanation into a tentative solution, 5) defining learning objective, 6) information gathering and private study, and 7) share the results of information gathering and private study [6].

There were 3 cases presented to students during seven synchronous meetings before the midterm exam, which

were discussed in small groups of 7 to 8 students. Cases were presented to students at the 2nd, 4th, and 6th meetings for cases 1, 2, and 3 respectively. Students conduct case analysis according to the seven jumps technique in synchronous and asynchronous group discussions after that and present the results of the discussions at the 3rd, 5th, or 7th meeting for each case.

The achievement of learning outcomes was observed from the mid-semester exam and the case resolution process scores. The average scores obtained by students from case-based learning are compared to the average scores of conventional method learning in the odd semester of the 2020/2021 academic year. A student satisfaction survey on the implementation of the case-based learning method was carried out after the mid-semester exam by distributing a questionnaire via a Google Form.

3. RESULTS AND DISCUSSION

Physical pharmacy is one of the critical aspects in developing pharmacy graduate competence. This course provides information on pharmaceutical formulations such as the physicochemical properties of drugs, the principle of reaction kinetics, and drug stability. The program learning outcome assigned to this course is "As a result of satisfactory completion of this course, the student should be prepared to design drug dosage forms and guarantee the quality of the products they produce". The course's learning outcomes are: 1) able to describe the physicochemical properties of medicinal raw materials and excipients and modify them to meet the compendial standards and 2) able to use them in designing dosage forms, evaluating formulations, and improving the bioavailability of dosage forms.

Students were exposed to 3 cases during seven meetings before the mid-semester exams. The cases are designed according to the problems that graduates will encounter when working in the pharmaceutical industry. The three cases were as follows:

Case I:

A pharmaceutical industry is developing an oral liquid preparation containing paracetamol as fever medicine for children. The R&D section explored the physicochemical properties of paracetamol in the literature. From the chemical structure, this drug is a weak organic acid and slightly soluble in water. The company decided to make paracetamol syrup in a clear solution so that children liked it. The R&D department needs to pay attention to the acid-base balance of paracetamol to determine the optimal solution pH in making paracetamol syrup preparations. What steps can you suggest?

Case II:

To develop an oral liquid preparation containing paracetamol as fever medicine for children, the R&D section of the pharmaceutical industry is exploring data on the chemical stability of paracetamol in solution. The first step is to estimate the shelf life of paracetamol in

syrup. The R&D department designed a kinetic test to see changes in paracetamol levels per unit time and calculate the t_{90} value (test result data attached). What kind of formulation and packaging techniques are designed to prevent drug degradation during storage? What efforts will you make to get a stable paracetamol syrup formula?

Case III:

The R&D department of the pharmaceutical industry has found the optimal formula for oral liquid preparations of paracetamol as fever medicine for children. The R&D department must complete the stability trials to meet the registration requirements. The Indonesian government refers to the ASEAN protocol (ASEAN Guideline on the Stability Study of Drug Products). How is the stability test protocol designed for paracetamol syrup? What is the output of the protocol? How to decide the results of the test parameters?

The learning process has been found to be effective because the students then have a reason to engage in group discussions. They must look for and understand learning materials from various sources to address the problems in their case studies. In their presentation slides, it appears that students have referred to Indonesian pharmacopeia. Previously, it was challenging to ask students to read the compendial book. Students understand well the relationship between cases and draw important conclusions, which are the learning outcomes of the course. Surprisingly, students ask questions that are the application of the knowledge being studied in a real context in the pharmaceutical industry. Questions like this rarely arise or occur in their minds with conventional learning methods.

Learning assessment consists of process and outcome assessments. The process assessment rubric contains assessment indicators such as individual participation in group and class discussions, presentation skills, and cognitive aspects of case solving. The students did the outcome assessment by answering 30 multiple choice questions online in the midterm exam. Results in Figure 1 indicate an increase in the average score of the students' midterm exams from $(52.39 \pm 14.47; n=71)$ for Class A; $(57.78 \pm 16.44; n=72)$ for Class B in the odd semester academic year 2020/2021 to $(71.69 \pm 11.38; n=67)$ for Class A; $(69.40 \pm 13.63; n=78)$ for Class B in the odd semester academic year 2021/2022. The data show that under the same conditions (40 minutes synchronous + 60 minutes asynchronous learning), students' ability to answer the questions increases after the case-based learning compared to conventional method learning.

Students' satisfaction was evaluated after the midterm exam through a questionnaire (Table 1). The ten questions rated students' perception of the learning and teaching method using a 4-point Likert scale at 4=strongly agree, 3=agree, 2=disagree, and 1=strongly disagree. Data were analyzed using Office Excel 2016 and indicate the average students' satisfaction of (75.65 ± 6.93) % of all items.

4. FIGURES AND TABLES

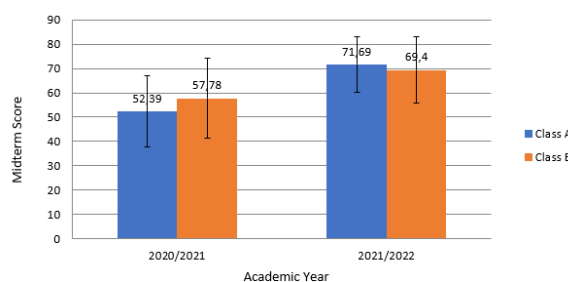


Figure 1. The average scores of students' midterm exams in academic year 2020/2021 and 2021/2022

Table 1. Student's satisfaction with the case-based learning method of Physical Pharmacy

No.	Statements	Students' satisfaction (%)
1.	The lecturer explained the stages of the Case-Based Learning Method (CBM) at the first meeting.	86.57
2.	The CBM learning method encourages me to look for lecture materials by utilizing various sources on the internet.	76.62
3.	Physical Pharmacy lectures using the CBM method integrate concepts in theory with their application in the production of drug dosage forms	76.39
4.	The case/scenario given by the lecturer gave me an idea about the application of the teaching material in drug product's design	72.45
5.	Brainstorming in group discussions led me to identify and find solutions to these cases	73.38
6.	Discussion in small groups helps me understand the teaching materials	64.12
7.	The presentation of the results of other group discussions adds to my understanding	73.61
8.	The CBM method in learning Physical Pharmacy has trained me to think critically in finding solutions to cases	73.38

9.	The brainstorming stage in group discussions trained me to be confident in expressing my opinion	74.07
10.	Lecturers give students the opportunity to ask questions and raise objections if they disagree	89.35

AUTHORS' CONTRIBUTIONS

The author is responsible for the revision of the Physical Pharmacy lecture's plan and the implementation of the new teaching and learning method in the lessons before the midterm exam.

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