

Implementation of the Case-Based Learning Method in Introduction to Circuit Analysis Course

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ABSTRACT

Classroom Action Research (CAR) is one of the techniques for lecturer-managed learning to improve through continuous improvement. CAR in the Introduction to Circuit Analysis course is carried out on the teaching-learning process and assessment of learning outcomes or assessments that occur in the classroom, intending to improve the quality of learning in this course. The learning method applied to this CAR is a case-based method called CBM. Activities in this research include planning and compiling scenarios or case studies to develop students' reasoning knowledge and skills in solving problems. The completion of the CBM scenario was completed by students in the form of small groups. In its implementation, students conduct small group discussions to solve the problems in the scenario to encourage students to get a Higher Order of Thinking Skill (HOTS) level. The results of the group discussions were presented in class and compiled in the form of a report. By applying the CBM learning method in the Introduction to Sequential Analysis course, the target achievement in mastery the material and composition of students who get good grades is more than 90% with the distribution of student scores ranging from A ($80 \leq SV \leq 100$) and A- ($75 \leq SV < 80$). The assessment of student responses to the development of learning methods and/or assessments applied from the survey results showed that 100% of students stated that this method was effective and suitable to be applied to the Introduction to Circuit Analysis course.

Keywords: CAR, Introduction to Circuit Analysis, Case-Based Method, Scenarios, HOTS.

1. INTRODUCTION

The Introduction to Circuit Analysis course (CCE61104) is one of the compulsory core courses in the curriculum structure of the Computer Engineering Department, Faculty of Information Technology, Andalas University. This course is a bridge between the basic foundation courses from the Mathematics and Basic Science group and the follow-up courses from the realm of Electronics and Embedded Systems. Thus, it is necessary to have a semester learning plan that ensures the suitability and continuity between the material that has been received in the prerequisite courses and the courses that require it. The contribution of learning outcomes targeted in this course to the competencies/learning outcomes of major graduates includes mastery of computing, ability to identify, formulate and solve problems in the field of computer engineering, ability to think critically and obey scientific rules, ability to use computational techniques and devices, good communication effective, as well as lifelong learning.

The learning objectives/outcomes in this course in terms of hard skills are: to understand and explain the history and developments about circuits and electronics correctly through joint discussions, to understand and explain electrical quantities and fundamental circuit elements correctly through class explanations and practicum, as well as analyze electrical circuits appropriately through example problems. In terms of soft skills, the learning outcome in this course is being able to apply principles and ethics in collaborating, discussing, synergizing, and solving problems in a small or large group.

The learning method applied in the previous semesters was the Student-Centered Learning (SCL) approach with the Cooperative learning (CL) method which focuses on learning outcomes. In this CL method, students who are members of a group have responsibilities both individually and in groups and work together to achieve learning objectives. Each member must have their own contribution both in terms of material and its role in completing the task to the fullest. The role of the lecturer in this method is the

transition from "sage on the stage" to "the guide on the side", that is, from explaining with a lecture approach in front of turning into a guide on the side of the group.

The assessment method in this course consists of an assessment of learning outcomes and an assessment of the process. Assessment of learning outcomes consists of quiz scores, assignments/practices, Mid-Semester Examinations (UTS), and Final Semester Examinations (UAS), which only rely on students' cognitive abilities, without any observation and assessment of psychomotor abilities and affective abilities during the learning process in class. The assessment process consists of assessing soft skill competencies, both intra-personal and inter-personal skills, and students' basic values (integrity, discipline, hard work, courtesy/ethics/having values, and self-confidence). The ability of new students can be known after the learning process ends (after UAS). Therefore, the lecturer has no time to correct the student's weaknesses.

In the even semester of the 2020/2021 academic year, the Introduction to Circuit Analysis course was participated by 97 students. The scores obtained by students ranged from grades E to A. The following distribution is the results of the assessment of students in the previous even semester shown in Figure 1.

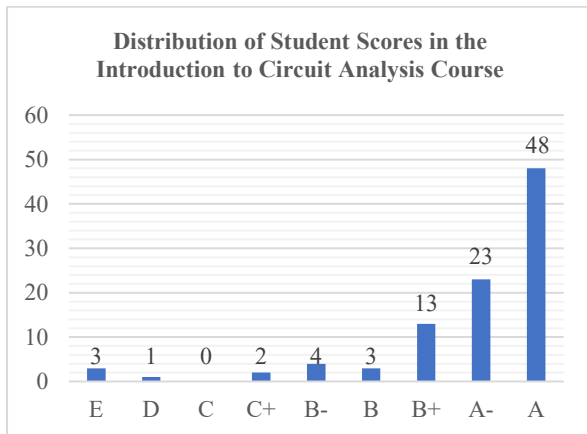


Figure 1. Distribution of student scores

The evaluation showed that the percentage of students who got an A is 50% (the highest), followed by A- 24% and B+ 13%. The percentages below 10% are B, B-, C+, C, D and E which are 3%, 4%, 2%, 0%, 1% and 3%, respectively. The composition of the scores above shows that the good grades obtained by students (grades B+ to A) have reached 87%. This is enough to prove that the graduation rate for this course is already in the good category. However, it is still very lacking when referring to the quality of mastery of the material. Therefore, it is necessary to have other strategies that can complement the current learning strategy, one of which is using the CBM method.

There is a paradigm shift in the implementation of learning that encourages lecturers to continue to develop learning methods more creatively and innovatively in presenting lecture material. To produce graduates who are productive, creative, and innovative. This can be realized by the implementation of learning that can be carried out in various scopes by using critical and creative thinking skills. The learning strategy that can be applied is learning by empowering Higher Order of Thinking Skills (HOTS).

HOTS [1] is critical in applying, linking, and modifying existing knowledge to solve new issues effectively. Higher-Order of Thinking Skill is the ability to think critically, logically, reflectively, metacognitively, and creatively which is a higher-order thinking ability. HOTS not only requires the ability to remember but requires other higher abilities, such as the ability to think creatively and critically. Higher-order thinking necessitates the application of new information or knowledge that has already been learned and the manipulation of that information to obtain the ability to respond in new situations. Bloom's thinking skills are divided into two categories; low-level thinking skills, which are knowledge, understanding, and application, and high-level thinking skills, which are made up of knowledge, understanding, and application. Analysis, synthesis, and evaluation are examples of advanced thinking skills [1].

1.1. Case-Based Method

Case-Based Method (CBM) is a teaching method that requires students to participate in real or hypothetical problem situations actively, which reflects the type of experience experienced naturally in the discipline being studied [2]. According to [3, 4, 5], the CBM method is very effective and has a positive impact on motivating students to improve their knowledge and skills in identifying the problems they face. Applying the CBM method in group discussion lectures is more effective in increasing student creativity and developing a positive attitude in learning to achieve better learning outcomes [6, 7]. CBM is an effective and interesting learning approach. In CBM, learning scenarios or case studies are used to develop students' reasoning knowledge and skills in solving the problems at hand. Case-based learning provides an opportunity to analyze content by first introducing the core knowledge domain and encouraging students to look for other knowledge domains that may be relevant to the problem given in this case.

The application of the case-based learning method is an opportunity for lecturers to apply to learn at the HOTS level. Through conversation and contemplation in groups discussion, decision-making, students are

motivated to integrate their prior experiences to assess cases and discover answers [8]. Thus, implementing a case-based method in the Introduction to Circuit Analysis course will offer significant benefits for both the lecturers and students.

1.2. Student Assessment Strategy

Assessment is the activity of measuring students' quality of knowledge, skills, and attitudes resulting from the learning process. The assessment can be done during the learning process and or at the end of the lesson to see students' achievement of learning objectives, both with formative and summative objectives. The implementation of summative or formative exams is no different, but formative exams do not affect students' grades and graduation. This formative exam is intended as feedback for students in their learning process.

The characteristics of an ideal learning strategy are valid, reliable, have a positive educational impact, are organized within a strong regulatory framework, are fair, and are supported by a good graduation standard-setting process [9]. These ideal characteristics need to be considered in the preparation and implementation of assessment strategies for students, consisting of determining assessment techniques, determining indicators, implementing measurements, and making decisions.

The assessment of student learning outcomes is expressed in numerical values, quality scores, quality scores, and quality designations by following the scale presented in table 1 below.

Table 1. Assessment of Student Learning Outcomes [10]

Score Value (SV)	Quality Score (QS)	Quality Value (QV)	Quality Designation
$80 \leq SV \leq 100$	A	4,00	Very Brilliant
$75 \leq SV < 80$	A-	3,75	Brilliant
$70 \leq SV < 75$	B+	3,50	Very good
$65 \leq SV < 70$	B	3,00	Well
$60 \leq SV < 65$	B-	2,75	Almost Good
$55 \leq SV < 60$	C+	2,50	More than enough
$50 \leq SV < 55$	C	2,00	Enough
$45 \leq SV < 50$	D	1,00	Not enough
45	E	0,00	Fail

1.3. The Framework of thinking

The form of the framework used in this study can be seen in Figure 2.

Based on the framework shown in Figure 2, it can be concluded that completing the learning strategies used today with the proper CBM method is expected to improve the quality of learning outcomes for the

Introduction to Circuit Analysis course in the odd semester of the 2021/2022 academic year, at the Department of Computer Engineering, Andalas University.

1.4. Action Hypothesis

Based on the background of the problem above, the writer can formulate the hypothesis of this Classroom Action Research as follows: By applying the Case-Based Method (CBM) learning method, it is suspected that it can improve the quality of student learning outcomes in the Introduction to Series Analysis course in the odd semester of the 2021/2022 academic year in the Computer Engineering Department, Andalas University.

2. METHOD

2.1 Research Subject

The subjects in this study were students of the Computer Engineering Department at Andalas University who took the Introduction to Circuit Analysis course in the odd semester of the 2021/2022 academic year. The number of students in this class is 2 people.

2.2 Action Settings

This classroom action research (starting from the planning to evaluation stage) was carried out within half of the odd semester of the 2020/2021 academic year. This research was carried out in June – October 2021. The planning stage was carried out in weeks 1-2, the implementation and observation stages were carried out throughout the meeting weeks 3-7. Then the evaluation stage is carried out on week 8.

The planning and evaluation of classroom action research activities are carried out in the Computer Engineering Department building, Andalas University. Considering the Covid-19 Pandemic condition, the implementation and observations were carried out in online classes through online learning media, namely Andalas University iLearn, which has been provided for teaching and learning activities for this Introduction to Circuit Analysis course. In addition, synchronous implementation (face to face) is carried out using the Zoom Cloud Meetings platform.

2.3 Research Procedure

This research was conducted using Classroom Action Research. The learning method used is a combination of the Teacher-Centered Learning (TCL) approach and the Student-Centered Learning (SCL) approach with the Case-Base Method learning method. This classroom action research was carried out with the following stages.

2.3.1. Planning

This planning stage identifies the factual problems that arise in the Introduction to Circuit Analysis lesson and analyzes the causes of these problems. Furthermore, detailed action plans are prepared through the development of Semester Learning Plans (RPS), preparation of Discussion Worksheets, and teaching materials. In this activity, indicators of the success of the action were also determined, and the instruments used to measure the success rate of the actions in the form of rubrics on the results of discussions, reports on discussion results, test questions on learning outcomes, quiz questions and questionnaires for student responses

to the ongoing learning process. This activity is carried out at week 1-2 meetings.

2.3.2. Action Execution

The learning method used is:

- a) Combination of TCL and SCL. In this method, the lecturer gives questions or practice questions to students, provides opportunities for students to think, and then discuss questions with their colleagues. Then the lecturer appointed several students to answer orally or explain through the screen on the Zoom Application. Then by utilizing the Discussion Forum feature on ILearn, students can also discuss with their peers and answer directly the practice questions given by the lecturer during lectures. The method applied is quite effective considering the limitations in the pandemic situation and can eliminate student boredom in understanding the material presented by the lecturer.

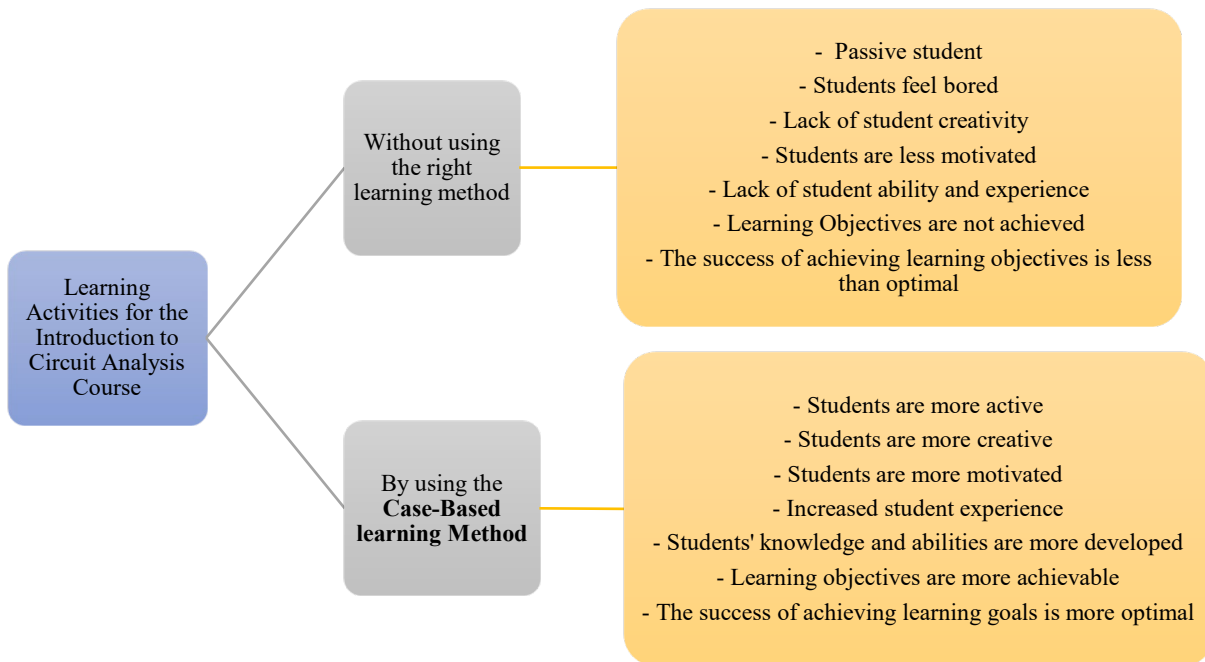


Figure 2. Framework of Thinking

- b) For certain topics, learning is carried out by combining the Cooperative Learning approach with the CBM learning method in the following ways:
 - Course participants will be divided into small groups consisting of 2 people.
 - The lecturer prepares case scenarios related to the topic to be discussed, and a list of study questions is presented at the end of each case.
 - In this approach, the lecturer acts as a tutor who will facilitate the discussion process.

- Students conduct small group discussions in solving the problems contained in the scenario.
- Students make group presentations on the results of the discussions that have been carried out.
- The results of the discussion activities are compiled in the form of a report

2.3.3. Observation

At this stage, the observations are made on the events encountered in the implementation of the action, including the obstacles encountered and the activities

carried out by students during the learning process. This activity is carried out simultaneously with the implementation of the action.

2.3.4. Evaluation

The last stage of this classroom action research is an evaluation of the entire research process. Several parameters will be used to assess the success of the teaching and assessment methods developed in this Classroom Action Research activity, that is:

- Learning outcomes will be measured by instruments; questions during presentations, discussion results reports, independent assignments, quizzes, and UTS exam questions.
- Distribution of final scores. This activity is considered successful if the percentage of students' scores below B is smaller than the previous academic year.
- Student responses to the development of applied learning and/or assessment methods.

3. RESULT AND DISCUSSION

3.1. Learning Outcomes at Odd Semester 2021/2022

The assessments carried out in this course include process assessments and results assessments. Assessment during the learning process involves independent assignments, quizzes, percentage assessments, and discussion results. At the same time, the assessment at the end of the learning process is through the Mid-Semester Examination.

The CBM method is applied to basic topics including the Basic Laws of Electricity, Circuit Analysis Methods, and Circuit Theorems in the learning process. Evaluation of learning outcomes for these topics is measured in the form of quizzes. The following is the distribution of quiz scores and independent assignments, which are presented in table 1.

Based on table 1, it can be seen that the evaluation carried out on the effect of this CBM approach on student activity in the learning process shows that this approach can increase the percentage of students who are actively involved in the learning process both in asking and responding to the material presented in group discussions and in working on the given questions. The distribution of students' final grades is presented in Figure 3.

Based on Figure 3, it can be seen that the distribution of final grades for the Introduction to Circuit Analysis course shows an increase by comparing the distribution of final grades for the Introduction to

Circuit Analysis course in the previous year. In this odd semester, all students' grades only revolve around grades A and A-, each with a percentage of 50%. Whereas in the previous year, the scores obtained by students still ranged from grades E to A. The assessment results showed that the distribution of scores for students of the Computer Engineering Study Program in the Introduction to Circuit Analysis course by applying the CBM learning method was better than the distribution of students' scores in the previous year.

3.2. Students Response to the Development of Applied Learning Method

Student responses to the development of learning methods applied to the Introduction to Circuit Analysis course were conducted by surveying the impact of the application of the CBM method in increasing student interest in learning and learning experiences. The population in this survey is all students participating in the Introduction to Circuit Analysis course. All members of the population are sampled. Measurement of student responses was carried out by distributing questionnaires to all students participating in the Introduction to Circuit Analysis course. The results of data processing using a Likert scale on the questionnaire showed that 100% of students stated that the method applied was effective. Students considered that the applied CBM learning method effectively improved soft skills and the learning experience gained, consisting of the ability to communicate, work together and complete assignments or homework in groups.

4. CONCLUSION

Based on the results of the classroom action research that has been carried out, it can be concluded that the application of the CBM learning method in the Introduction to Circuit Analysis course is considered to be able to achieve the target, which is mastery of the learning material. The composition of students who get good grades is more than 90%. So that the success of learning achievement from this course can be more optimal.

Students' perceptions of this CBM learning method indicate that the method applied is effective in improving student skills through case-based learning experiences so that it can provide a basic understanding for students about the introduction to circuit analysis as a requirement to continue the study of Electrical Circuit course and Electronics course in the next semester.

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Table 2. Class Descriptive Statistics Quiz & Assignments

No	Topics	Number of Students	Lowest Score	Highest Score	Average Score
1	Basic Laws of Electricity	2	90	95	92,5
2	Circuit Analysis Methods	2	78	89	83,5
3	Circuit Theorems	2	75	88	81,5

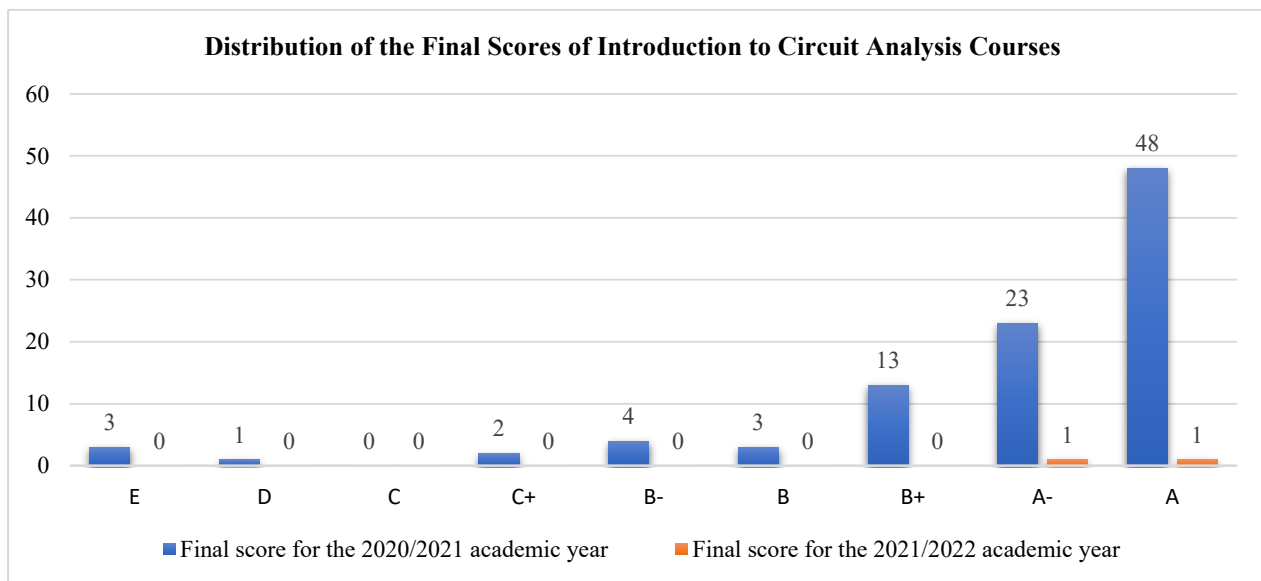


Figure 3. Distribution of Student Final Scores

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