Kolb's Experiential Learning Model to Improve Students' Critical Thinking Skills in Educational Research Methodology Courses

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Abstract. The purpose of this research is to produce an effective Kolb experiential learning model to enhance critical thinking skills and to determine the feasibility and effectiveness of the Kolb experiential learning model. The ADDIE model serves as the basis for the research and development method. (R&D). This study was conducted by the Mechanical Engineering Education Study Program, Faculty of Engineering, Unimed, in the course on Educational Research Methodology. The subjects of the research development procedure for the Kolb experiential learning model are expert groups, namely: learning material experts, media learning experts, and instructional design experts, followed by individual testing, small group testing, and field testing on students. The research results are shown in the feasibility test from expert validation, as well as student trials and practicality tests, all of which indicate that the Kolb experiential learning model can be used in the learning process, and students' critical thinking skills have also improved. In the effectiveness test on students' learning outcomes in educational research methodology, the average score of the experimental class (using the Kolb experiential learning model) is higher than the control class. (conventional learning model).

Keywords: experiential kolb, research literacy, critical thinking, educational research methodology.

1 Introduction

Human life is significantly impacted by education. In addition to scientific and technological advancements, In order to improve the quality of human resources and compete on a global scale, human beings must be able to think creatively, effectively, and innovatively. The four pillars of life: learning to do, learning to know, learning to be, and learning to coexist remain essential in the twenty-first century. Specific abilities that must be strengthened in learning activities are found in each of these four principles, including problem-solving, critical thinking, metacognition, communication skills, teamwork, invention, and creation [1].

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Based on the observations and evaluations of the educational research methodology course faced by students in the course, it is still low and can vary depending on their experience and expertise. The following are some common problems faced by students: (1) difficulty understanding basic concepts, (2) limited statistical knowledge, (3) writing research proposals, (4) selecting research topics, (5) data collection, (6) data analysis, (7) time and project management, (8) uncertainty in developing hypotheses, (9) communication and presentation, and (10) literature evaluation.

Problem-solving skills need to be instilled in students through active learning activities in educational research methodology courses. Active learning is based on the constructivist view that emphasizes problem-solving-oriented learning to encourage students to actively do something to transform information into knowledge [2]. Student knowledge is not obtained from external sources, such as in the lecture model, but from activities carried out by themselves. Active student involvement will build their cognitive abilities in thinking critically, logically, and systematically in solving various problems related to learning materials. One form of active learning that can develop students' problem-solving abilities is experiential learning.

Students are personally involved in the topics or concerns under study through the experiential learning methodology [3]. Students can effectively learn from their own experiences by using this learning style. In educational research methods, experiential learning is used effectively to help students improve their problem-solving skills. This is related to the material in Educational Research Methodology which integrates statistical knowledge, research implementation, data collection, data processing, test requirements, research requirements, and data analysis.

The experiential learning paradigm was developed on the basis of Kolb's theory, which emphasizes the significance of experience in the learning process. The experiential learning approach, which is based on an epistemological perspective, is consistent with constructivism learning theory, which enables students to make meaning of their learning experiences [4]. The experiential learning model consists of four stages: active exploration, abstract conceptualization, reflective observation, and concrete experience [5]. People create meaning from their experiences during the phases of tangible experience, reflective observation, and abstract conceptualization. Active experimentation, abstract conception, reflective observation, and actual experience are the four stages of the experiential learning model. The experiential learning approach helps improve students' capacity for critical thought. Thinking and critical are the two words that make up critical thinking. Kowiyah [6], thinking how to formulate problems, plan solutions, review steps for solutions, and make assumptions if the data presented is incomplete, requires a thinking activity called critical thinking.

Samsudin [7], the application of experiential learning models can improve cognitive learning outcomes and physics problem-solving abilities of junior high school students. Syafriani [8] said that the application of experiential learning models (experiential learning) with an inquiry approach can improve science process skills in light material in two experimental classes of junior high school students with a moderate category. Research from Dale [9] students can find out more information about what they are "doing." Edgar Dale also explains that experiential learning is an experience obtained by students as a result of their own activities; students are directly related to the objects to be studied.

Alamanda and Calila [10], the experiential learning model can be used as an alternative learning model to change and improve students' conceptual understanding of the material on the properties of light, used as a measuring tool for changes in student conceptions, used as a learning activity that supports a fun, scientific learning process, and provides good conceptual understanding results. Manolas' research [11] demonstrates how students can be inspired to choose learning and challenged to develop their critical thinking and problem-solving skills through the experiential Kolb learning paradigm.

One of the ten fundamental abilities that students must acquire and cultivate in order to thrive in the present and the future is critical thinking. Additionally, according to the WEF survey results, industry will require about 37% of these abilities in the next years. According to Changwong et al. [12], Critical thinking, according to the National Council of Excellence in Critical Thinking (NCECT), is "the process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication." Critical thinking is the process of understanding, applying, analyzing, synthesizing, and evaluating information obtained by observation, experience, introspection, reasoning, or communication. The similar assertion is made by Sianturi et al. [13] Critical thinking is a skill that involves evaluating and analyzing information. Accordingly, Freely asserts in Handayani [14] that critical thinking may help students justify problems and draw conclusions in addition to helping them analyze, critique, and generate ideas.

Critical thinking ability is an activity that requires detailed thinking about what has been observed to solve a problem with reasoning and proper decision-making [15]. While the capacity to answer a variety of mathematical issues including mathematical knowledge, mathematical reasoning, and mathematical proof is known as critical thinking ability in mathematics [16].

Create the following research problem: In the course on educational research methodology, how feasible is the experiential Kolb-based learning model? (2) How effective is the experiential Kolb-based learning model? (3) How do students' critical thinking skills in experiential Kolb-based learning in the course on educational research methodology fare?

2 Method

This research, which involves research and development (R&D), was developed using the ADDIE approach. The steps in the ADDIE Model Development Procedure are analysis, design, development, implementation, and assessment. The four phases of the Kolb Experientia Learning Model are as follows: The first four elements are active exploration, abstract conceptualization, introspective observation, and concrete experience. Because the previously acquired experience can be applied to novel encounters or challenging circumstances, a meaningful process will now take place [17].

Table 1. Learning Process Experiential Learning (Kolb)

Ability	Description	Experience
Concrete experience (CE)	Pupils give their all to novel experiences	Feeling

Reflection observation (RO)	Students watch, consider, or contemplate events from a variety of angles	Watching
Abstract conceptualization (AC)	Students develop ideas that incorporate what they've seen into theories	Thinking
Active experimentation (AE)	Students use theories to solve problems and make decisions	Doing

The Department of Mechanical Engineering Education, Faculty of Engineering, Unimed, carried out this study as part of the course on Educational Research Methodology. The research focused on the process of developing experiential Kolb-based learning devices in expert groups, which included specialists in instructional design, graphic design, learning media, and learning materials. The development research involved students and lecturers as subjects in field experiments, small group trials, validation group trials, and individual trials.

To ascertain whether the creation of the experiential Kolb-based learning model in the Educational Research Methodology course is practicable to implement, professors with backgrounds in media and learning design undertook this expert validation test. The following formula can be used to determine the validation test results:

Description:

$$\text{Percentage} = \frac{\sum score\ per\ item}{\sum maximum\ score} \text{ x } 100\%$$

The expert validation results are then adjusted to the criteria in the following Table 2:

Table 2. Conversion of Feasibility Level

Achievement Level (%)	Category	Description
81 – 100	Very Feasible	No need to revise
61 – 80	Feasible	No need to revise
41 – 60	Quite Feasible	Revised
21 – 40	Less Feasible	Revised
0 – 20	Not Feasible	Revised

Effectiveness analysis was conducted using learning outcome tests. The difference between the average posttest scores of the experimental and control classes was used to assess how well the experiential Kolb-based learning model development process worked in the Educational Research Methodology course.

Making Use of the T-Test in Analysis The test uses either an independent sample t-test or an independent two sample t-test. The t-test is used to see if the average of one sample group is different from the average of another. This study employs a "pretest-posttest control group design." Sukmadinata [18], where each class's control class is selected at random. the Kolb experiential learning paradigm and a conventional learning model in the control group. Two prerequisites must be satisfied before using the t-test to analyze data: the normality and homogeneity requirements.

The N-Gain value will be determined using the outcomes of the two classes' pretest and posttest. N-Gain is the difference between the actual score and the maximum score that can be attained. Table 3 displays the criteria used to determine the n-gain value.

Table 3. N-Gain Value Category

Value	Category
value < 0,3	Low
0,3 ≤ value ≥ 0,7	Medium
0,7 > value	High

The average of one group is then compared to another using a t-test to see if there is a difference [19]. One parametric statistical test for assessing significance and relevance in one or two sample groups is the t-test [20]. The n-gain findings of the experimental class and the control class were compared in this study to determine the t-test.

3 Results and Discussion

3.1 Research Results

According to the findings of a number of expert validation tests, these include: (3) an expert in learning media with an average score of 3.92 with very feasible criteria; (4) an expert in learning design with an average score of 3.91 with very feasible criteria; (5) small group trials with an average score of 3.94 with very feasible criteria; (6) main/field trials of students with an average score of 3.90 with very feasible criteria for the use or application of the Experiential Kolb-based learning model in the educational research methodology course; and (5) an expert test of the educational research methodology material with an average score of 3.87 with very feasible criteria.

Table 4 below displays the findings of the N-Gain calculation for the experimental and control classes on (1) student critical thinking abilities and (2) educational research method ability:

Table 4. N-Gain Values of Control and Experimental Classes on Improving Critical Thinking Skills

Class	Average Value		N-Gain	Interpretation
	Pretest	PostTest		
Control	50,23	79,21	0,59	Medium
Experimental	51,72	87,62	0,75	High
Average	50,975	83,415	0,67	Medium

The experimental class's posttest score on students' critical thinking abilities is higher than that of the control group, according to Table 4's N-Gain value. With an average posttest score of 87.62, the experimental class N-Gain's posttest score falls into the high group at 0.75. In contrast, the control class's average posttest score is 79.21, with a medium category and an n-gain of 0.59. The n-gain value calculation indicates that the experimental class's use of students' critical thinking abilities outperforms the control group.

Tabel 5. N-Gain Value of Control and Experimental Classes on Educational Research Methods Ability

Class	Average Value		N-Gain	Interpretation
	Pretest	PostTest		
Control	52,25	78,23	0,57	Medium
Experimental	55,74	89,65	0,78	High
Average	53,99	83,94	0,675	Medium

The experimental class that used the Kolb experiential learning model had a higher posttest value than the conventional learning group, according to Table 5's N-Gain values. With an average posttest score of 89.65, the experimental class N-Gain's posttest score falls into the high group at 0.78. In contrast, the control class's average posttest score is 78.23, with a medium category and an n-gain of 0.57. Learning with the Kolb experiential learning model applied to the experimental class of the Educational Research Methodology topic is more effective than traditional learning, according to the computation of the n-gain value.

Table 6. t-Test Results

Class	Number of Students	t_{count}	T_{table}	sig.
Control	15	5,87	2,048	$1,8^{-07}$
Experimental	15			

The t-test results are displayed in Table 6. The findings indicate that the significance value is 0.00000018 and the t-value is 5.87. According to this, the hypothesis is accepted since the t-value (5.87) > t-table (2.048) and the sig. value is less than 0.005. Based on these findings, it can be concluded that the Kolb experiential learning model and traditional learning in the course on educational research methodology differ significantly. Students' marks in the Educational Research Methodology course have improved as a result of this change.

Observing the notable improvement in students' critical thinking abilities in the Educational Research Methods material between the pretest and posttest results following the implementation of the Kolb experiential learning model indicates that the model can be beneficial.

3.2 Discussion

The foundation of Kolb's experiential learning methodology is constructivist learning theory. Collaborative learning techniques, giving students' activities precedence over those of teachers, problem-solving, brainstorming, field experiences, case studies, simulations, and laboratory exercises are some of the most common constructivist learning practices [21]. The distribution of scores for improving students' critical thinking skills may be seen by comparing the average pretest-posttest scores and students' N-gain on educational research techniques content. The results of the tests that were given showed that the average score on the posttest was greater than the score on the pretest. The average post-test score was higher than the pretest, indicating that students' critical thinking skills have typically improved based on the data from the pretest and posttest.

Jannati's research [22] demonstrates that: (1) Using the Experiential Kolb learning model can greatly enhance students' conceptual understanding when compared to traditional models; and

(2) Students respond favorably to using the Experiential Kolb learning model on optical instrument content.

The experiential Kolb learning model provides opportunities for students to express everyday experiences as a basis for understanding concepts that ultimately students are able to classify optical instrument learning. Reflective observation makes students more free to learn independently and exchange ideas with each other in conducting experiments. Here students are required to be active in learning. This is in line with the view put forward by Nur and Wikandari [23] that teachers can help students construct their knowledge with teaching methods that make the information provided by the teacher very meaningful and relevant to students and by providing opportunities for students to find and establish their own ideas for learning.

The hypothesis test's findings demonstrate that using the experiential Kolb learning model enhances conceptual knowledge more than using traditional learning models. The experiential Kolb model applied to the experimental class can explore students' experiences as basic capital in discovering new concepts. This is in line with the statement of Ausubel and Dahar [24], who stated that in order for new learning to be obtained by students, it must be linked to concepts that already exist in the student's cognitive structure. In addition, the experiential Kolb learning model trains students' ability to formulate hypotheses through experimental activities, so that after going through this learning process, students can understand the concepts learned.

The Kolb experiential model with virtual media improves students' conceptual understanding compared to the application of conventional models. This is in accordance with what Yezierski and Birk, Kolomuc [25] expressed, namely to help students understand physics by improving their ability to visualize processes down to the particle level that occur at the microscopic level.

The combination of these varied learning devices with the Kolb experiential learning model has an even better impact. Because with this approach, students are able to construct their own understanding, which can make students understand the concept better. Lecturers can provide students with learning devices that bring students to a higher understanding, with the note that students themselves must be constructive [26]. So that the lecturer here only acts as a facilitator who guides students so that they can find their own new knowledge.

Since students must be active and creative in their knowledge creation, several research support the Kolb experiential model with virtual visualization as one of the best options. Determining the growth in conceptual comprehension following the use of the Kolb experiential model with virtual visualization was the aim of this study. Mechanical Engineering semester IIA used as the experimental class for the Control Group Pretest-Posttest Design research design [27].

Mursid [28], stated that, improving learning outcomes is very helpful in achieving the quality of science and knowledge in their fields, problem solving, developing interests and talents, and utilizing holistic and successful event learning methodologies to employ technology in the twenty-first century to foster critical and creative thinking abilities. Students will find the educational research methods course engaging and enjoyable if it emphasizes problem-solving techniques and develops their thought process into a critical thinking component.

4 Conclusion

It is possible to conclude that, from the first to the sixth meeting, there was a greater implementation of the learning process through the use of the Kolb experiential learning model in the educational research methods material based on the research data, data processing, research findings, and discussion of how the model was applied to enhance students' critical thinking abilities. The Kolb experiential model's average application falls into the very good range. Students' critical thinking abilities in the Educational Research Methods course can be greatly enhanced by implementing the Kolb experiential learning approach. The medium category normal gain index shows how much pupils' critical thinking abilities have improved on average. The obstacle to implementing the Kolb experiential learning model is the limited time for implementation in class. This is due to the amount of time needed in each stage. Therefore, to apply this learning model, it is recommended that lecturers have the ability to allocate time, pay attention to teaching materials, and have good classroom management.

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