The Effect of Critical Thinking on Digital Electronics 2 Courses Based on Online Learning

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ABSTRACT

This study aims to reveal the level of contribution of the creative thinking learning model, by observing the factors that support student interest in learning. The number of respondents in this study were 22 students who took digital electronics courses 2 for the 2020/2021 academic year in the Electrical Engineering department of UNESA using quantitative methods which were then processed based on descriptive statistics. The results of the 20 questionnaires used r-count with a range of 0.614916 to 0.627607 with an r-table of 0.195. of the parameters used, we state that the 20 questionnaires distributed are valid to be given to respondents with the intent and purpose that has been submitted previously. Creative thinking learning can be seen based on 5 competency criteria, namely Fluent Thinking competency criteria, Flexible Thinking competency criteria, Original Thinking competency criteria, Elaboration Thinking competency criteria, and Evaluative Thinking competency criteria where the results can be seen based on Q1 to Q20.

Keywords: Likert Scale, Creative Thinking, Online Learning.

1. INTRODUCTION

With the advancement of educational technology and supporting internet infrastructure during the COVID-19 pandemic, we as academics are required to continue to carry out education in a sustainable manner, so that during the pandemic every educator is required to carry out online educational activities through existing media [1]. In the time we have lived during the pandemic, we have become accustomed to carrying out online learning activities even though there are still limitations in delivering material to students. Each university prepares online learning facilities based on web content such as VINESA, which is one of the Moodle-based online learning applications provided by UNESA to support educational activities. In addition to the facilities provided by educational institutions, the motivation of students to participate in online-based educational activities is also inseparable. Students must be able to adapt in various conditions so that education continues so that in the future students are able to become quality human beings and have global competitiveness. One of the indicators as quality human beings and has global competitiveness, students must have good skills,

abilities, and attitudes. The skills possessed by students are supporting technical skills, critical thinking skills and creativity.

The principle of critical thinking/critical thinking in the process of various disciplines actively and skilfully participates in conceptually translating, analysing, synthesizing, applying, and evaluating all the information obtained [2]. We can analogize critical thinking by processing evaluation at a higher cognitive level, providing criticism, and synthesis. Critical thinking skills can be broken down into analysis, interpretation, evaluation, inference, and accompanied by a reasonable assessment. Critical thinking arises from a person's internal motivation towards a statement or problem faced which can be realized in the form of an oral or written model. We can find the low critical thinking of students in several causes of learning aspects such as aspects of synthesizing, analysing, and evaluating information. Learning that exists today we often encounter in the form of theoretical and rote. The learning obtained comes from online and offline source books with the memorization concept learning method. In today's era with increasingly advanced technology, critical thinking is one of the skills that is indispensable and can be used to face changing

challenges and living conditions in the world. In addition to critical thinking, students are required to have the creative ability to find something new in facing challenges in society.

Students as individual academics should have high creativity. Creativity is a product of internal and external prerequisites for one's cognitive. Internal prerequisites that affect creativity are abilities, interests, intelligence, knowledge, and education. External prerequisites that affect creativity include economic, physical, and cultural factors. Both of these prerequisite factors must be maximized in education so that students can follow lessons better and face various problems related to environmental problems, the rise of the creative and cultural industry, advances in technology and information, as well as educational education at the national and international levels.

National education supervision in Indonesia shows that the Indonesian formal education system still lacks opportunities for developing critical and creative thinking in general. There is a ranking survey on the level of educational creativity in Indonesia against other countries which is still very low. On the other hand, there is also a research survey on the higher learning process in Indonesia which still does not empower students to think creatively.

The majority of students in Indonesia have low performance in critical thinking because higher education institutions have not implemented 21st century education, which requires students to be able to analyse, evaluate, build, evaluate, and conclude knowledge and find solutions to several problems. Several other studies also show that students' critical thinking skills are still low. Based on observations with samples conducted at the Department of Electrical Engineering, State University of Surabaya from July-August 2021, it is clear that students who take the Digital Electronics 2 course have low performance in analysing, evaluating or inferring knowledge. This is also supported by the results of a survey through the Google Form platform for odd semesters for the 2020/2021 academic year, where most of the students answered surveys from the provided google form.

Students' creativity should be facilitated by learning activities that allow them to explore ideas and respond to a problem. However, the facts show that most students are used to accepting what is conveyed by the teacher without trying to find out for themselves. Today's education requires graduates to have high-level skills such as innovation and creativity. Therefore, learning must be designed to support student creativity, especially in generating creative ideas.

The explanation above shows that critical thinking and creativity are both needed today in the 21st century. Therefore, it is necessary to conduct research to test students' critical thinking skills and creativity in learning subjects in the field of Electrical Engineering, especially the Digital Electronics 2 course as well as to know the relationship between critical thinking and creativity.

2. STYLE PALETTE

2.1. Creative Thinking

Creativity is the ability to formulate ideas, seek new relationships, create new or unexpected answers, formulate concepts that are not easy to remember, produce new answers to original problems, and ask new questions. Creativity is a person's ability to produce compositions, products, or ideas that are basically new, and previously unknown to the creator. The main criterion in creativity is to produce a product.

In summary, creative thinking is a pattern of thinking that is based on a way that encourages us to produce creative products.

2.2. Likert Scale

According to experts, the Likert scale has a broad spectrum, the Likert scale is a method of scaling the attitude statement. He uses the response as a distribution and determinant of the value of the scale used for the research carried out.

There are several categories of responses that can be used by researchers, namely strongly agree responses which are abbreviated as strongly agree, agree, quite agree, disagree, and strongly disagree.

When giving answers, subjects were asked to answer honestly, so that the Likert measurement scale was more accurate and reliable. The answers that have been obtained from the respondents will be collected, then analyzed to obtain research results.

Likert scale can be used to measure the attitudes of respondents. It can also be used to see the opinions or perceptions of a person or group of people, so as to get the right answer for the social phenomenon under study.

In order to provide a measurement of the right answer, the researchers used research instruments in the form of questionnaires or questionnaires. The collection of answers is then carried out and analyzed, so as to produce answers that are in accordance with the phenomenon under study.

2.3. Questionnaire Making Technique

After determining the type of scale to be used in the study, the next step is to make a questionnaire. The questionnaire is a set of formal questions to obtain information from respondents. In making the questionnaire there are three objectives. First, to translate the researcher's information needs into a specific set of questions that respondents are willing and able to answer.

Second, the written questionnaire was able to motivate respondents to engage and work together. Third, the questionnaire made must be able to minimize answer errors.

The form of questions in the questionnaire can be positive and negative questions. Positive questions are questions that lead to a positive opinion or highlight someone's ability. While negative questions are reverse questions by highlighting negative opinions or opinions that lead to limitations [6].

2.4. Correlation Pearson

The instrument validation test was carried out before the questionnaire was distributed to the respondents. The purpose of this instrument validation test is to avoid statements that are not clear what they mean.

Testing the validity of the questionnaire instrument was carried out using a Likert scale (1 to 5). Test the validity of the Likert scale questionnaire using the Pearson correlation described in equation 1

$$r_{XY} = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - \left(\sum X\right)^2} \sqrt{n\sum Y^2 - \left(\sum Y\right)^2}} \quad (1)$$

Description:

rXY : correlation coefficient validity

n   : number of respondents

X   : comparison value

Y   : the value of the instrument whose validity

        is sought

3. METHODOLOGY

In this study, we used several steps carried out to obtain research results. The steps we took are as shown in Figure 1.

The activity stage for carrying out the research described in Figure 1 is the first to collect supporting references regarding the determination of the creative thinking survey instrument to students.
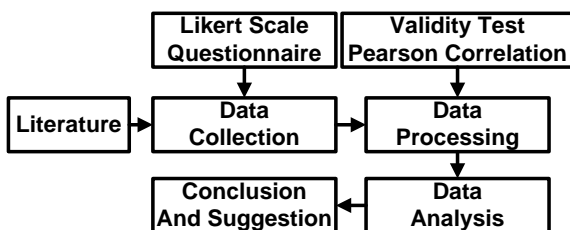

Figure 1 Research Method.

By compiling items of questions that refer to the factors that influence the research. To compile the statement items, these factors are translated into a grid of research instruments which are then developed into questions or statements. The statement items must be an elaboration of the contents of the factors that have been described, then translated into existing indicators arranged items that can provide an overview of the state of these factors. The statement items compiled in this study are positive supporters. This positive statement of support is intended to vary the statement so that it is not monotonous and boring.

Then we conducted an online questionnaire using the Likert scale method. The questionnaire was conducted by distributing the google form link to students who had attended lectures. to determine students' ability to think critically and creatively. The data obtained by the survey instrument will be analyzed descriptively correlational to describe critical thinking skills, creativity, and the relationship between critical thinking and student creativity. The population of this study were 22 students of the Department of Electrical Engineering Education who took the Digital Electronics 2 course. The population sample method was used as a sampling technique. Students' critical thinking skills were evaluated as a Gkita choice test with a Likert scale method consisting of 20 questions for creative thinking which were divided into 5 competency criteria, namely Fluent Thinking competency criteria, Flexible Thinking competency criteria, Original Thinking competency criteria, Elaboration Thinking competency criteria, and criteria Evaluative Thinking competence. The survey was validated before use. The survey was validated by the Pearson Correlation method. Data is collected from the survey scores that have been assigned to students. Students' answers to creative thinking questions were assessed using a 5-scale rubric, with 5 = Strongly Agree, 4 = Agree, 3 = Moderately Agree, 2 = Disagree, and 1 = Strongly Disagree. The scoring on the survey using the Likert scale method in this study dominates the positive results compared to the negative results, which aims to improve students' creative thinking patterns with the assumption that lecturers who teach actively provide learning materials that encourage students to apply the criteria of creative thinking competence.

Quantitative data in this study were analyzed using statistical calculation analysis techniques in tabular form. This study uses quantitative data analysis in the form of descriptive for each question instrument given to students. Regression analysis technique is used to see the relationship between critical thinking skills and students' creativity.

The next activity stage is to test the validation of questionnaire data that has been filled out by alumni using Pearson correlation. In the data analysis stage, the percentage obtained for each positive supporting

question given from the alumni recorded. From the data analysis, we were able to review the distribution of the number of positive supporting question points related to the support of alumni's ability to think creatively.

The 20 questions of the questionnaire are divided into 5 competency criteria, namely:

Q-1 to Q-4 are the competency criteria for Fluent Thinking

Q-5 to Q-8 is the competency criteria for Flexible Thinking

Q-9 to Q-12 are criteria for Original Thinking competence

Q-13 to Q-16 are criteria for Elaboration Thinking competence

Q-17 to Q-20 are criteria for Evaluative Thinking competence

20 Questions used to collect data using a google form survey. These 20 questions are divided into 2 types of questions, namely positive questions and negative questions.

Q-1 = I ask a lot of questions when learning the processing circuit and the counter circuit (positive question type)

Q-2 = Questions arise when there are things that are not clear and detailed when the lecturer explains the material for the processing circuit and the enumerator circuit (positive type of question)

Q-3 = I answer the lecturer's question with only one answer (type of negative question)

Q-4 = I find it difficult to express the ideas I have (negative question type)

Q-5 = I have various interpretations of a series of processors and counters (positive question type)

Q-6 = I have various interpretations of a story or problem given by the lecturer (positive type of question)

Q-7 = I work on the questions with the same steps as taught by the lecturer (negative question type)

Q-8 = I think of many different ways to solve a problem (positive type of question)

Q-9 = I can think of things that other people don't think about (positive type of question)

Q-10 = I am confused when the lecturer gives a question that is different from the example (negative question type)

Q-11 = I just thought of the ways that the lecturer taught me to solve a problem (positive type of question)

Q-12 = I choose to think like other friends because I am afraid that my thinking is wrong (negative question type)

Q-13 = I believe in the answers given by the lecturer in each question given as an example (type of negative question)

Q-14 = I like to add a friend's opinion after he gives his opinion so that my opinion is more complete. (positive question type)

Q-15 = I believe in the answers given by a friend in every question given as a practice test (negative question type)

Q-16 = I like to add symbols, values, complete descriptions and analyze circuit pictures that I draw myself (positive question type)

Q-17 = I am afraid that it will be wrong to express my opinion about something (negative type of question)

Q-18 = The opinion I put forward is based on my own point of view (positive type of question)

Q-19 = I am easily influenced by other people's opinions (negative question type)

Q-20 = I have justifiable reasons for each of my opinions (positive question type)

In questions 1 (Q-1) to question 20 (Q-20) we want to know the distribution of students in technical creative thinking in digital electronics 2 courses through the Likert scale method with question instruments that have been validated using Person correlation with a level significance (α) was determined at 0.05 and the number of respondents was 22 respondents who came from all students taking digital electronics 2 courses.

4. RESULTS AND DISCUSSION

The results of the data we obtained, we analyzed based on statistics spread on a Likert scale. The data obtained is to determine the ability of technical creative thinking in digital electronics 2. The data is presented in the form of a table accompanied by a description.

The 20 questionnaires that we use are presented for each questionnaire question data.

Table 1 Questionnaire 1 (Q-1).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	6	27%
3	Quite agree	10	45%
2	Disagree	5	23%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 1 of the Q-1 questionnaire, the percentage value of the total approval decision obtained is 77% of the types of positive questions asked, stating that most students ask a lot of questions when learning the processing circuit and the enumerator circuit takes place. In this percentage, it is necessary to increase the initiative and motivation of students in actively asking many questions when learning the processing circuit and the enumerator circuit takes place.

Table 2 Questionnaire 2 (Q-2).

Value	Information	Respondents	Percentage
5	Strongly agree	3	14%
4	Agree	11	50%
3	Quite agree	7	32%
2	Disagree	1	5%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 2 the Q-2 question questionnaire, the percentage value of the total approval decision obtained is 87% of the types of positive questions asked stating that students ask questions if there are things that are not clear and detailed when the lecturer explains the material for the processing circuit and the enumerator circuit being taught. . This indicates that students are very active in teaching and learning activities.

In table 3 the Q-3 question questionnaire, the percentage value of the total approval decision obtained is 82% of the types of negative questions asked stating that there are still many students who answer the lecturer's questions with only one answer so that it needs to be increased again students' creativity in answering questions from the lecturer.

In table 4 the Q-4 question questionnaire, the percentage value of the total approval decision obtained is 77% of the types of negative questions asked stating that there are still many students who have difficulty in conveying their ideas to support teaching and learning activities

Table 3 Questionnaire 3 (Q-3).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	13	59%
3	Quite agree	4	18%
2	Disagree	2	9%
1	Strongly disagree	2	9%

| | Amount | 22 | 100% |

Table 4 Questionnaire 4 (Q-4).

Value	Information	Respondents	Percentage
5	Strongly agree	4	18%
4	Agree	8	36%
3	Quite agree	5	23%
2	Disagree	4	18%
1	Strongly disagree	1	5%
	Amount	22	100%

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Table 5 Questionnaire 5 (Q-5).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	14	64%
3	Quite agree	6	27%
2	Disagree	1	4%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 5 the Q-5 questionnaire, the percentage value of the total approval decision obtained is 96% of the types of positive questions asked stating that the majority of students have various interpretations of a series of processors and enumerators taught by lecturers.

In table 6 the Q-6 questionnaire, the percentage value of the total approval decision obtained is 95% of the types of positive questions asked stating that the majority of students have various interpretations of a story or problem given by the lecturer so that we can call it learning carried out by students. very active in creative thinking

Table 6 Questionnaire 6 (Q-6).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	14	64%
3	Quite agree	6	26%
2	Disagree	1	6%
1	Strongly disagree	0	0%
	Amount	22	100%

Table 7 Questionnaire 7 (Q-7).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	17	77%
3	Quite agree	3	14%
2	Disagree	1	5%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 7 the question questionnaire Q-7 on the percentage value of the total approval decision obtained is 96% of the types of negative questions asked stating that the majority of students are still working on the questions with the same steps as taught by the lecturer so that creativity needs to be increased again in solving problems/problems. given.

Table 8 Questionnaire 8 (Q-8).

Value	Information	Respondents	Percentage
5	Strongly agree	2	9%
4	Agree	14	64%
3	Quite agree	5	23%
2	Disagree	1	5%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 8 the Q-8 questionnaire, the percentage value of the total approval decision obtained is 96% of the types of positive questions asked stating that the majority of students are able to think of various different ways to solve a problem, so that lecturers are greatly helped by students' creative thinking.

Table 9 Questionnaire 9 (Q-9).

Value	Information	Respondents	Percentage
5	Strongly agree	0	0%
4	Agree	13	59%
3	Quite agree	7	32%
2	Disagree	2	9%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 9 the Q-9 questionnaire, the percentage value of the total approval decision obtained is 91% of the types of positive questions asked stating that they can think about things that other people don't think of so that we as researchers can consider students' thinking including active creative thinking.

Table 10 Questionnaire 10 (Q-10).

Value	Information	Respondents	Percentage
5	Strongly agree	3	14%
4	Agree	10	45%
3	Quite agree	7	32%
2	Disagree	2	9%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 10 the Q-10 question questionnaire, the percentage value of the total agreement decision obtained is 91% of the types of negative questions asked stating that the majority of students are confused in solving problems when getting different questions so it is necessary to expand students' thinking in supporting their creativity to solve problems in the form of development or the questions given are different from what is taught.

Table 11 Questionnaire 11 (Q-11).

Value	Information	Respondents	Percentage
5	Strongly agree	3	14%
4	Agree	3	14%
3	Quite agree	8	36%
2	Disagree	7	32%
1	Strongly disagree	1	5%
	Amount	22	100%

In table 11 of the Q-11 questionnaire, the percentage value of the total approval decision obtained is 64% of the types of positive questions asked stating that the majority of students think about the ways taught by the lecturer to solve a problem. From this analysis, we can say that students are able to provide several ways to solve a problem.

Table 12 Questionnaire 12 (Q-12).

Value	Information	Respondents	Percentage
5	Strongly agree	3	14%
4	Agree	7	32%
3	Quite agree	5	23%
2	Disagree	6	27%
1	Strongly disagree	1	5%
	Amount	22	100%

In table 12 of the Q-12 questionnaire questions, the percentage value of the total approval decision obtained is 69% of the types of negative questions asked stating that the majority of students still follow a way of thinking that has similarities with their friends so it is necessary to increase student confidence so that they do not always follow the opinion / solution from a friend

Table 13 Questionnaire 13 (Q-13).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	16	73%
3	Quite agree	5	22%
2	Disagree	0	0%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 13 of the Q-13 questionnaire, the percentage value of the total approval decision obtained is 100% of the types of negative questions asked stating that the majority of students always trust the answers given by the lecturer in every question given as an example. From this analysis, it is necessary to increase students' self-confidence so that they do not always trust the completion of each given question, students must have sufficient knowledge, and be able to think creatively in solving problems.

In table 14 of the Q-14 questionnaire, the percentage value of the total approval decision obtained is 100% of the types of positive questions asked stating that the majority of students have motivation in adding/refuting their friends' opinions to be more complete.

Table 14 Questionnaire 14 (Q-14).

Value	Information	Respondents	Percentage
5	Strongly agree	4	18%
4	Agree	11	50%
3	Quite agree	7	32%
2	Disagree	0	0%
1	Strongly disagree	0	0%
	Amount	22	100%

Table 15 Questionnaire 15 (Q-15).

Value	Information	Respondents	Percentage
5	Strongly agree	1	5%
4	Agree	5	23%
3	Quite agree	15	68%
2	Disagree	1	5%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 15 of the questionnaire questions Q-15, the percentage value of the total approval decision obtained is 95% of the types of negative questions asked stating that the majority of students still trust the answers from the solutions given by their friends. To overcome this, students must be able to think creatively in answering questions and always analyze something first.

Table 16 Questionnaire 16 (Q-16).

Value	Information	Respondents	Percentage
5	Strongly agree	2	9%
4	Agree	14	64%
3	Quite agree	5	23%
2	Disagree	1	5%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 16 of the questionnaire questions Q-16 the percentage value of the total approval decision obtained is 95% of the types of positive questions asked stating that the majority of students are always motivated to add something more complete to their own work in the form of symbols, values, information and others.

Table 17 Questionnaire 17 (Q-17).

Value	Information	Respondents	Percentage
5	Strongly Agree	2	9%
4	Agree	8	36%
3	Quite Agree	5	23%
2	Disagree	6	27%
1	Strongly Disagree	1	5%
	Amount	22	100%

In table 17 of the Q-17 questionnaire, the percentage value of the total approval decision obtained is 68% of the types of negative questions asked stating that the majority of students are less confident than something stated.

Table 18 Questionnaire 18 (Q-18).

Value	Information	Respondents	Percentage
5	Strongly agree	3	14%
4	Agree	12	55%
3	Quite agree	5	23%
2	Disagree	2	9%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 18 of the Q-18 questionnaire, the percentage value of the total approval decision obtained is 91% of the types of positive questions asked stating that the majority of students are able to express their opinions from their own point of view.

Table 19 Questionnaire 19 (Q-19).

Value	Information	Respondents	Percentage
5	Strongly agree	2	9%
4	Agree	6	27%
3	Quite agree	9	41%
2	Disagree	5	23%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 19 of the Q-19 questionnaire, the percentage value of the total approval decision obtained is 77% of the types of negative questions asked stating that the majority of students are still easily influenced by the opinions of others.

Table 20 Questionnaire 20 (Q-20).

Value	Information	Respondents	Percentage
5	Strongly agree	4	18%
4	Agree	14	64%
3	Quite agree	4	18%
2	Disagree	0	0%
1	Strongly disagree	0	0%
	Amount	22	100%

In table 20 of the Q-20 questionnaire, the percentage value of the total approval decision obtained is 100% of the types of positive questions asked stating that the majority think that every opinion will have accountability.

Of the 20 questionnaires made previously, we tested the validation of the questionnaires that had been carried out/distributed so that the validation of the questions used in the questionnaires and used to avoid statements that were not clear in meaning, the 20 questionnaires used r-count with a range of 0.614916 to 0.627607 accompanied by r- the table is 0.195. From the parameters used, we state that the 20 distributed questionnaires are valid to be given to respondents with the aims and objectives that have been submitted previously

5. CONCLUSION

From the analysis and discussion that has been done previously, we can conclude broadly on the questionnaire data that we have done from the four criteria used in creative thinking such as Fluent Thinking, Flexible Thinking, Original Thinking, Elaborating Thinking, and Evaluative Thinking, the majority of students agree on creative thinking of the 5 competency criteria used, but according to the types of questions asked, both have almost the same high percentage so that we need to make creative thinking instruments that are more suitable for students and before distributing them to students, it needs to be socialized first

In future research, it is expected to use critical thinking instruments and can also be combined with creative thinking

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