

## The Effectiveness of Concept Attainment Model (CAM) with Concept Mapping Technique on Students' Creative Thinking Skills

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**ABSTRACT** - This study aims to explain the effectiveness of the Concept Attainment Model (CAM) with concept mapping technique on student's creative thinking skills. The quasi-experimental method use one group pretest-posttest design for this study. This research was conducted on 107 high school students with 32 males and 75 females (average age 16-17 years) in Rengel, Tuban, Indonesia who were divided into 3 groups (groups A, B, and C). Creative thinking skills are assessed using a creative thinking skills assessment rubric based on concept map. The pre-post test of creative thinking skills scores were analyzed using paired t-test, effect size, and n-gain. The results showed that there were significant differences and improvements in creative thinking skills seen from the pre-post test scores, the CAM learning materials with the concept mapping technique on creative thinking skills has a high effect (strong effect), and the CAM with the concept mapping technique can improve creative thinking skills (medium category). Thus, it can be concluded that the learning is said to be effective in terms of students' creative thinking skills in 3 groups which experienced an average increase of medium category.

**Keywords:** Concept attainment model, Concept mapping, Creative thinking skills

**ABSTRAK** –Penelitian ini bertujuan untuk menjelaskan efektivitas Concept Attainment Model (CAM) dengan teknik Concept Map untuk meningkatkan keterampilan berpikir kreatif siswa. Metode quasi-eksperimental dengan one group pretest posttest design digunakan penelitian ini. Penelitian ini dilakukan pada 107 siswa sekolah menengah dengan 32 siswa laki-laki dan 75 siswa perempuan (usia rata-rata 16-17 tahun) di Rengel, Tuban, Indonesia yang dibagi menjadi 3 kelompok (grup A, B, dan C). Keterampilan berpikir kreatif dinilai menggunakan rubrik penilaian keterampilan berpikir kreatif berbasis peta konsep. Skor keterampilan berpikir kreatif dari pre-post test dianalisis menggunakan uji-t berpasangan, effect size, dan n-gain. Hasil penelitian menunjukkan bahwa ada perbedaan yang signifikan dan peningkatan keterampilan berpikir kreatif dilihat dari skor pre-post tes, materi pembelajaran CAM dengan teknik Concept Map terhadap keterampilan berpikir kreatif memiliki efek tinggi (efek kuat), dan CAM dengan teknik pemetaan konsep dapat meningkatkan keterampilan berpikir kreatif (kategori sedang). Dengan demikian dapat disimpulkan bahwa pembelajaran dikatakan efektif ditinjau dari keterampilan berpikir kreatif siswa pada 3 kelompok yang mengalami peningkatan rata-rata kategori sedang.

**Kata Kunci:** Concept attainment model, Concept mapping, Creative thinking skills

## INTRODUCTION

In the 21st century, students must have various skills to be able to face various challenges and succeed in the midst of a very fast and dynamic world development. Students must have various skills in the 21st century, including creative thinking skills, critical thinking and problem solving, communication, and collaboration. One of the important skills to be developed in the world of education is creative thinking skills (Turkmen, 2015). This statement is in line with the goal of national education, namely to create a generation that has the ability to create something new and become people who have creative thinking skills (Anwar & Rasool, 2012). Creative thinking skills are a source of strength for humans to advance various things including in terms of exploration, development, new discoveries in the fields of science and technology, and all fields of human endeavor (Ghufron & Risnawati, 2014). Various abilities that reflect students having creative thinking skills are fluency, flexibility, originality, and elaboration of an idea (Munandar, 2009).

However, in reality, the goals of national education have not been in accordance with what is desired. Based on the results of Sari's research (2016), the creative thinking skills of 54 students obtained an average percentage of 39.76%, so it is included in the quite low category. This is supported by the results of the researcher's observations in 2019 in one of the high schools which showed that students answered the questions give the same way as given by the teacher. Students have not been able to create new ideas or innovate in solving physics problems, students are only able to follow the stages given by the teacher, and only answer and calculate the problems given without understanding the problem as a whole, therefore students' creative thinking skills are classified as low (Mihardi et al., 2013). This is in line with what Tamba (2017) said, that when students are given physics problems, most of them only provide answers without being supported by related reasons. The solution that can be used so that students can have good creative thinking skills is to use the right learning model.

Concept Attainment Model (CAM) is a learning model that asks students to find and list essential properties so that they can distinguish between examples and non-examples of a concept (Huda, 2017). The purpose of the Concept Attainment Model (CAM) is to help students understand a learning concept (Uno, 2017). CAM has three stages of the learning process. The first stage is categorization, which is categorizing phenomena that are appropriate

and inappropriate to a concept. The second stage is to adjust the appropriate category and eliminate the inappropriate category, after which the appropriate categories are combined and a concept is formed. The third stage is to conclude the results based on the second stage, then students obtain a concept (Uno, 2017). Then efforts to develop creative thinking skills can be done by building thinking skills through mapping techniques or often known as concept maps (Sudarma, 2013). Concept mapping is a learning strategy that asks students to synthesize or create an image containing related main concepts, the relationship between concepts is marked by an arrow (Zaini, 2008). Creative thinking skills can be stimulated through concept maps because all indicators of creative thinking skills can be assessed based on concept maps. Fluency indicators are seen based on the many concepts that are correctly initiated by students, flexibility indicators can be seen from the way students see one material from various perspectives so as to produce various cross-links, detail indicators can be seen from students' ability to detail a material in detail so as to produce a concept map that has many branches, and originality indicators can be seen from concept maps that are unique, symmetrical, interesting, and different from others. This research was conducted because there has been no previous research that discusses the concept attainment model with concept mapping techniques to improve creative thinking skills.

In addition, research by Suprpto, et al. (2018) remarks that concept maps can be made manually or using software. Making concept maps manually can use a pencil, while concept maps with the help of software can use an application called mi-Mind (Syawaludin, 2020). The results of the study indicate that the use of concept maps has been proven to facilitate students in learning. Also, Alkilany (2017) showed the usefulness of concept maps in mathematics learning and had a positive effect on student creativity. Concept maps and creativity influence each other and provide many benefits for students and teachers (Alkilany, A. 2017). Thus, we provide innovation by adding concept map techniques on Concept Attainment Model (CAM) learning.

In this study, concept maps techniques were created using an application called mi-Mind. The research of Nurseto (2019) show that the use of the mi-Mind application is quite effective in improving learning achievement and can reduce students' habits of misusing smartphones. The use of the mi-Mind application was used to improve students' creative thinking skills and make it easier for teachers to assess creative thinking skills based on the concept maps

produced. Therefore, we create the Concept Attainment Model (CAM) Learning Syntax with Concept Mapping Technique syntax was presented in Table 1.

**Table 1.** Concept Attainment Model (CAM) Learning Syntax with Concept Mapping Technique

No.	Steps	Activity
1.	Data presentation and concept identification	<ul style="list-style-type: none"> <li>- The teacher presents several examples that have been labeled (each example has been grouped into examples and non-examples).</li> <li>- Students compare the properties or characteristics of examples and non-examples.</li> <li>- Students conclude and test hypotheses.</li> <li>- Students create a definition according to essential characteristics.</li> <li>- The teacher introduces a concept map using manual methods or through software called mi-Mind.</li> <li>- The teacher explains how to create a concept map</li> </ul>
2.	Testing the achievement of the concept	<ul style="list-style-type: none"> <li>- Students identify additional examples that are not labeled by the teacher with a "Yes" or "No" mark</li> <li>- The teacher confirms the hypothesis, concept name, and definition according to the essential characteristics.</li> <li>- Students create other examples that refer to the concept.</li> <li>- The teacher asks students to create a concept map using the mi-Mind application on the material on work and energy.</li> <li>- Students create a concept map through the following 5 steps:               <ol style="list-style-type: none"> <li>1) Brainstorming</li> <li>2) Determining the main concept (topic)</li> <li>3) Writing and arranging concepts in the form of images</li> <li>4) Connecting concepts with a line</li> <li>5) Labeling at the top of the arrow line</li> </ol> </li> </ul>
3.	Analyzing strategic thinking skills	<ul style="list-style-type: none"> <li>- The teacher asks students to analyze or discuss the strategies they use in making concept maps.</li> <li>- Students describe their thoughts.</li> </ul>

No.	Steps	Activity
		<ul style="list-style-type: none"> <li>- Students discuss the role of traits and hypotheses.</li> <li>- Students discuss the types and varieties of hypotheses.</li> </ul>

Source: Adapted from Joyce, et al. (2009)

In summary, this study aims to determine the effectiveness of the Concept Attainment Model (CAM) with the concept mapping techniques on high school students' creative thinking skills. In order to avoid differences in understanding of the problems to be studied and to make it easier for researchers to explain what is being discussed, this study only focuses on the topic of work and energy of X grade. In addition, the assessment of students' creative thinking skills uses indicators of students' creative thinking abilities put forward by Munandar (2009). This research is designed to improve creative thinking skills, alternatives for physics teachers in choosing learning models so that they can improve the learning system, and contribute to improving the quality of teaching and learning.

## METHOD

The research design used is descriptive quantitative with a one group pretest posttest design. This design can be described as follows on Table 2.

**Table 2.** One Group Pretest Posttest Design

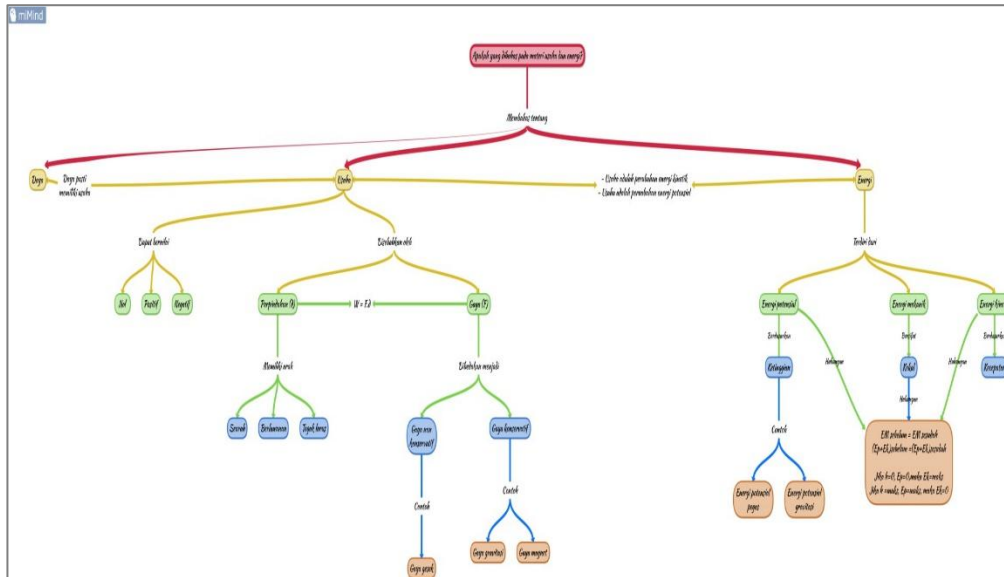
Pretest	Treatment	Posttest
O <sub>1</sub> (Pretest score before being given treatment)	X (Treatment by implementing the CAM learning process with the concept mapping technique)	O <sub>2</sub> (Posttest score after receiving treatment)

Source: Sugiyono (2015)

This research was conducted in one of the schools in Rengel, Tuban, Indonesia with 107 subjects of the study in grade X, the students consisted of 32 males and 75 females in group A, group B and group C.

Creative thinking skills are assessed using a creative thinking skills assessment sheet instrument. This study describes the effectiveness of the

CAM with the concept mapping technique for the creative thinking skills of high school students. The assessment of creative thinking skills is assessed based on the concept map made by students. Figure 1 show examples of concept map results created by using the mi-Mind application.



**Figure 1.** Concept map results created by using the mi-Mind application.

The concept map is assessed based on the assessment formulated by Suprpto, et al. (2018) and the indicators explained by Munandar (2009). The assessment rubric used can be seen in Table 3.

**Table 3.** Creative Thinking Skills Rubric Based on Concept Maps

Indicator	Description	Criteria	Skoring
Fluency	Can produce multiple concepts fluently	Focus Question: A	5 = correct question focus
		focused question	3 = standard question focus
		establishes the context of a concept.	0 = no question focus on the concept map
Context:	A brief description of the focus of the question.	A	5 = good/appropriate context
		brief	3 = standard context
		description of the focus of the question.	0 = no appropriate context
Parking lots:	Contains a list of concepts that are	lots:	1 point for each appropriate concept, then count all concepts that are connected to other

Indicator	Description	Criteria	Scoring
		usually represented by symbols or events.	concepts through propositions.
Flexibility	Being able to see one material from various perspectives so that it can produce various cross-links, producing levels from general concepts to specific concepts.	Cross links: The way or method by which concepts can be connected Hierarchy: Levels from general to specific concepts	Point Grouping = x 1 Open Grouping = x 2 Closed Grouping = x 3 4 = correct concept at the same level 3 = there is one concept removed 0 = there are two concepts removed
Elaboration	Can detail a material to produce a concept map that has many branches and relationships between concepts.	Branching: The degree of differentiation between general or specific concepts Proposition: The relationship between concepts represented by words or phrases.	Total x 1 1 = each proposition ½ = proposition used repeatedly 2 = scientific proposition 1 = scientific proposition used repeatedly.
Originality	Can produce concept maps that are unique, symmetrical, interesting and different from others.	Create a unique concept map, attractive colors, relatively different from other students, and relevant to the material on work and energy.	4 = unique, symmetrical, interesting and different concept map from others 3 = unique, less symmetrical and different concept map from others 2 = standard, less symmetrical and different concept map from others 1 = same concept map as others

The score of each student is calculated using the following Equation 1.

$$Student\ grades = \frac{Number\ of\ scores\ obtained}{Maximum\ score} \times 100\% \quad (1)$$

The creative thinking scores of students obtained are used to determine the level or degree of creative thinking of each student. Students' creative thinking skills are divided into 5 categories was adapted by Khanafiyah &

Rusilowati (2016) which was shown in Table 4. Students are said to be creative if the results of the creative thinking test score are  $\geq 61.2\%$  (Khanafiyah & Rusilowati (2016).

**Table 4.** Criteria for Students' Creative Thinking Skills

Average Score Interval	Score Criteria
$81.59 \leq x < 100,00$	Very creative
$61.20 \leq x < 81.59$	Creative
$40.79 \leq x < 61.19$	Quite creative
$20.39 \leq x < 40.79$	Less creative
$0.00 \leq x < 20,39$	Not creative

The creative thinking skill scores obtained in the pretest and posttest were then analyzed using several statistical techniques, namely paired t-test analysis, effect size analysis, and n-gain analysis.

## RESULT AND DISCUSSION

The results of students' creative thinking skills were obtained after the learning process was carried out. Creative thinking skills were measured twice, namely before (pretest) and after (posttest) carrying out learning activities with the Concept Attainment Model (CAM) with the concept mapping technique. The findings and discussion are presented in the sub-analysis of students' creative thinking skills, paired t-test, effect size, and n-gain.

### *Analysis of students' creative thinking skills*

Students' creative thinking skills are expressed in the form of numbers between 1.00-100.00. Data on the results of students' creative thinking skills in the pretest and posttest of work and energy material are in Tables 5, Table 6, and Table 7.

**Table 5.** Results of Pretest and Posttest of Creative Thinking Skills of Group A

No.	Student	Pretest	Category	Posttest	Category
1	Student 1	35.89	Less Creative	58.37	Quite Creative
2	Student 2	39.23	Less Creative	81.34	Creative

No.	Student	Pretest	Category	Posttest	Category
3	Student 3	51.67	Quite Creative	70.81	Creative
4	Student 4	46.41	Quite Creative	76.56	Creative
5	Student 5	34.45	Less Creative	67.46	Creative
6	Student 6	38.76	Less Creative	74.64	Creative
7	Student 7	39.23	Less Creative	80.38	Creative
8	Student 8	42.11	Quite Creative	77.03	Creative
9	Student 9	48.80	Quite Creative	61.24	Creative
10	Student 10	44.02	Quite Creative	79.43	Creative
11	Student 11	45.93	Quite Creative	82.30	Very Creative
12	Student 12	42.11	Quite Creative	72.25	Creative
13	Student 13	47.85	Quite Creative	89.00	Very Creative
14	Student 14	42.11	Quite Creative	68.42	Creative
15	Student 15	43.06	Quite Creative	67.94	Creative
16	Student 16	52.63	Quite Creative	74.64	Creative
17	Student 17	48.33	Quite Creative	69.86	Creative
18	Student 18	45.93	Quite Creative	78.47	Creative
19	Student 19	55.50	Quite Creative	87.08	Very Creative
20	Student 20	61.24	Creative	68.90	Creative
21	Student 21	52.63	Quite Creative	73.21	Creative
22	Student 22	44.02	Quite Creative	81.34	Creative
23	Student 23	48.33	Quite Creative	67.46	Creative
24	Student 24	35.41	Less Creative	59.33	Quite Creative
25	Student 25	36.36	Less Creative	41.15	Quite Creative
26	Student 26	35.41	Less Creative	85.17	Very Creative
27	Student 27	44.02	Quite Creative	69.86	Quite Creative

No.	Student	Pretest	Category	Posttest	Category
28	Student 28	43.06	Quite Creative	75.12	Creative
29	Student 29	49.76	Quite Creative	75.60	Creative
30	Student 30	43.06	Quite Creative	63.16	Creative
31	Student 31	41.63	Quite Creative	77.51	Creative
32	Student 32	39.23	Less Creative	42.11	Quite Creative
33	Student 33	48.80	Quite Creative	72.73	Creative
34	Student 34	47.85	Quite Creative	83.25	Very Creative
35	Student 35	56.46	Creative	82.30	Very Creative
Average		44.89	Quite Creative	72.44	Creative

Table 5 shows that the average pretest of students in Group A is 44.89 in the quite creative category. While the average posttest of students is 72.44 in the creative category.

**Table 6.** Results of Pretest and Posttest of Creative Thinking Skills of Students in Group B

No.	Student	Pretest	Category	Posttest	Category
1	Student 1	53.59	Quite Creative	81.34	Creative
2	Student 2	47.37	Quite Creative	71.77	Creative
3	Student 3	35.41	Less Creative	77.51	Creative
4	Student 4	64.11	Creative	72.73	Creative
5	Student 5	37.80	Less Creative	71.29	Creative
6	Student 6	28.71	Less Creative	67.94	Creative
7	Student 7	32.54	Less Creative	72.73	Creative
8	Student 8	46.89	Quite Creative	59.33	Quite Creative
9	Student 9	53.11	Quite Creative	89.47	Very Creative
10	Student 10	43.06	Quite Creative	80.86	Creative

No.	Student	Pretest	Category	Posttest	Category
11	Student 11	37.80	Less Creative	81.34	Creative
12	Student 12	48.33	Quite Creative	82.78	Very Creative
13	Student 13	46.41	Quite Creative	83.25	Very Creative
14	Student 14	56.46	Quite Creative	86.12	Very Creative
15	Student 15	51.67	Quite Creative	80.38	Creative
16	Student 16	51.20	Quite Creative	87.08	Very Creative
17	Student 17	42.11	Quite Creative	68.90	Creative
18	Student 18	39.23	Less Creative	72.73	Creative
19	Student 19	38.28	Less Creative	74.64	Creative
20	Student 20	55.50	Quite Creative	83.25	Very Creative
21	Student 21	52.63	Quite Creative	86.12	Very Creative
22	Student 22	49.76	Quite Creative	88.04	Very Creative
23	Student 23	33.97	Less Creative	78.47	Creative
24	Student 24	37.32	Less Creative	51.67	Quite Creative
25	Student 25	41.15	Quite Creative	71.29	Creative
26	Student 26	41.15	Quite Creative	66.51	Creative
27	Student 27	38.76	Less Creative	67.94	Creative
28	Student 28	41.15	Quite Creative	77.03	Creative
29	Student 29	42.11	Quite Creative	73.68	Creative
30	Student 30	44.02	Quite Creative	71.29	Creative
31	Student 31	55.50	Quite Creative	82.78	Very Creative
32	Student 32	49.76	Quite Creative	74.64	Creative
33	Student 33	46.89	Quite Creative	75.60	Creative
34	Student 34	46.89	Quite Creative	48.80	Quite Creative
35	Student 35	44.02	Quite Creative	86.12	Very Creative

No.	Student	Pretest	Category	Posttest	Category
	Average	44.99	Quite Creative	75.58	Creative

Table 6 shows that the average pretest of students in Group B is 44.99 in the quite creative category. While the average posttest of students is 75.58 in the creative category.

**Table 7.** Results of Pretest and Posttest of Creative Thinking Skills of Students in Group C

No.	Student	Pretest	Category	Posttest	Category
1	Student 1	42.58	Quite Creative	79.90	Creative
2	Student 2	38.76	Less Creative	53.59	Quite Creative
3	Student 3	36.36	Less Creative	65.07	Creative
4	Student 4	44.02	Quite Creative	82.78	Very Creative
5	Student 5	41.15	Quite Creative	83.25	Very Creative
6	Student 6	41.15	Quite Creative	80.86	Creative
7	Student 7	41.15	Quite Creative	71.77	Creative
8	Student 8	51.67	Quite Creative	73.68	Creative
9	Student 9	51.20	Quite Creative	70.81	Creative
10	Student 10	37.32	Less Creative	62.20	Creative
11	Student 11	54.55	Quite Creative	84.69	Very Creative
12	Student 12	42.11	Quite Creative	74.64	Creative
13	Student 13	47.37	Quite Creative	83.25	Very Creative
14	Student 14	47.85	Quite Creative	80.38	Creative
15	Student 15	47.85	Quite Creative	79.90	Creative
16	Student 16	54.55	Quite Creative	60.29	Quite Creative
17	Student 17	63.16	Creative	81.82	Very Creative

No.	Student	Pretest	Category	Posttest	Category
18	Student 18	52.63	Quite Creative	75.60	Creative
19	Student 19	50.24	Quite Creative	87.08	Very Creative
20	Student 20	54.55	Quite Creative	87.08	Very Creative
21	Student 21	55.50	Quite Creative	76.56	Creative
22	Student 22	44.98	Quite Creative	65.07	Creative
23	Student 23	57.89	Quite Creative	73.68	Creative
24	Student 24	42.11	Quite Creative	71.77	Creative
25	Student 25	52.63	Quite Creative	69.86	Creative
26	Student 26	42.11	Quite Creative	70.81	Creative
27	Student 27	41.15	Quite Creative	70.81	Creative
28	Student 28	45.45	Quite Creative	60.29	Quite Creative
29	Student 29	52.63	Quite Creative	70.81	Creative
30	Student 30	45.93	Quite Creative	58.37	Quite Creative
31	Student 31	55.50	Quite Creative	67.94	Creative
32	Student 32	42.11	Quite Creative	85.17	Very Creative
33	Student 33	50.72	Quite Creative	68.90	Creative
34	Student 34	50.72	Quite Creative	74.64	Creative
35	Student 35	49.76	Quite Creative	67.94	Creative
36	Student 36	45.45	Quite Creative	72.73	Creative
37	Student 37	58.37	Quite Creative	83.25	Very Creative
Average		48.34	Quite Creative	Quite Creative	Creative

Table 7 shows that the average pretest of class Group C students is 48.34 in the quite creative category. While the average posttest of students is 74.11 in the creative category

### *The paired t-test results*

After the pretest and posttest were conducted, a paired t-test was conducted to determine any significant differences in the creative thinking skills obtained. The results of the t-test can be seen in Table 8.

**Table 8.** Results of Paired t-Test Analysis

Class	$t_{count}$	$t_{table}$	Conclusion
Group A	15.41	2.03	H <sub>0</sub> was rejected
Group B	18.76	2.03	
Group C	16.99	2.02	

Based on Table 8, there were significant differences and improvements in creative thinking skills as seen from the pretest and posttest scores obtained.

### *The effect size results*

The Concept Attention Model (CAM) with the concept mapping technique on creative thinking skills was analyzed using the effect size test. Table 9 shows the results of calculations using the effect size test.

**Table 9.** Results of the Effect Size Test of Creative Thinking Skills

Class	Effect Size Value	Category
Group A	3.10	High
Group B	3.53	High
Group C	3.43	High

Based on Table 9, it is known that the effect size value is  $> 1.00$  so it can be concluded that the use of the Concept Attainment Model learning material with the concept mapping technique on creative thinking skills has a high effect (strong effect).

### *Analysis of the improvement of students' creative thinking skills using n-gain*

The increase in students' creative thinking skills was analyzed using n-gain which showed the difference in students' creative thinking skills between after

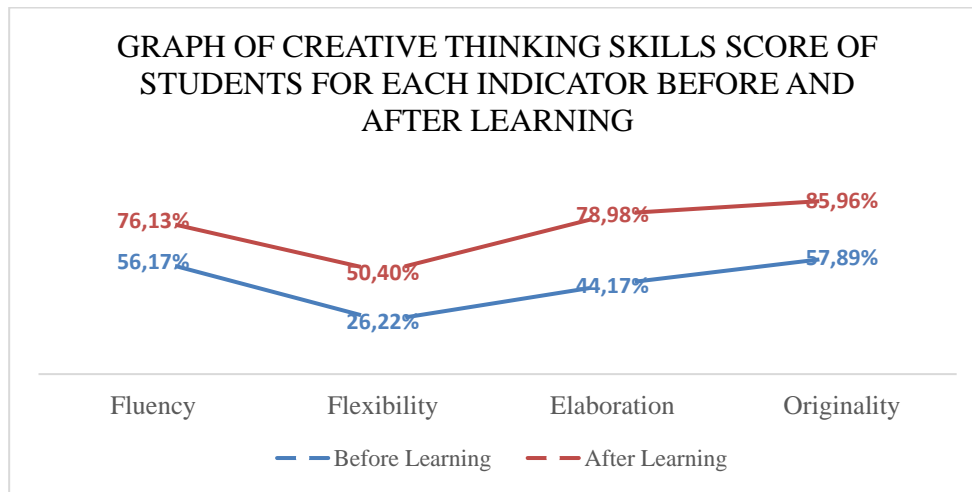
and before learning using the Concept Attainment Model (CAM) with the concept mapping technique. The increase in students' creative thinking skills can be seen in Table 10.

**Table 10.** Increase in Students' Creative Thinking Skills

No.	Name	Group A		Group B		Group C	
		Gain	Category	Gain	Category	Gain	Category
1	Student 1	0.35	Medium	0.60	Medium	0.65	Medium
2	Student 2	0.69	Medium	0.46	Medium	0.24	Low
3	Student 3	0.40	Medium	0.65	Medium	0.45	Medium
4	Student 4	0.56	Medium	0.24	Low	0.69	Medium
5	Student 5	0.50	Medium	0.54	Medium	0.72	High
6	Student 6	0.59	Medium	0.55	Medium	0.67	Medium
7	Student 7	0.68	Medium	0.60	Medium	0.52	Medium
8	Student 8	0.60	Medium	0.23	Medium	0.46	Medium
9	Student 9	0.24	Low	0.78	Low	0.40	Medium
10	Student 10	0.63	Medium	0.66	Medium	0.40	Medium
11	Student 11	0.67	Medium	0.70	Medium	0.66	Medium
12	Student 12	0.52	Medium	0.67	Medium	0.56	Medium
13	Student 13	0.79	High	0.69	High	0.68	Medium
14	Student 14	0.45	Medium	0.68	Medium	0.62	Medium
15	Student 15	0.44	Medium	0.59	Medium	0.61	Medium
16	Student 16	0.46	Medium	0.74	High	0.13	Low
17	Student 17	0.42	Medium	0.46	Medium	0.51	Medium
18	Student 18	0.60	Medium	0.55	Medium	0.48	Medium
19	Student 19	0.71	High	0.59	Medium	0.74	High
20	Student 20	0.20	Low	0.62	Medium	0.72	High

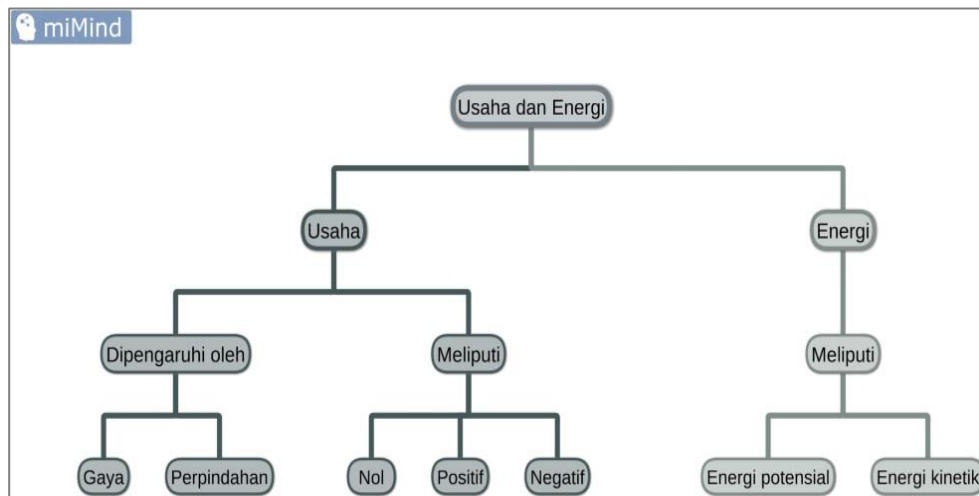
No.	Name	Group A		Group B		Group C	
		Gain	Category	Gain	Category	Gain	Category
21	Student 21	0.43	Medium	0.71	High	0.47	Medium
22	Student 22	0.67	Medium	0.76	High	0.37	Medium
23	Student 23	0.37	Medium	0.67	Medium	0.38	Medium
24	Student 24	0.37	Medium	0.23	Low	0.51	Medium
25	Student 25	0.08	Low	0.51	Medium	0.36	Medium
26	Student 26	0.77	High	0.43	Medium	0.50	Medium
27	Student 27	0.46	Medium	0.48	Medium	0.50	Medium
28	Student 28	0.56	Medium	0.61	Medium	0.27	Low
29	Student 29	0.51	Medium	0.55	Medium	0.38	Medium
30	Student 30	0.35	Medium	0.49	Medium	0.23	Low
31	Student 31	0.61	Medium	0.61	Medium	0.28	Low
32	Student 32	0.05	Low	0.50	Medium	0.74	High
33	Student 33	0.47	Medium	0.54	Medium	0.37	Medium
34	Student 34	0.68	Medium	0.04	Low	0.49	Medium
35	Student 35	0.59	Medium	0.75	High	0.36	Medium
36	Student 36					0.50	Medium
37	Student 37					0.60	Medium
Average		0.50	Medium	0.56	Medium	0.49	Medium

Based on Table 10, it is known that Concept Attainment Model (CAM) learning with concept mapping technique can improve creative thinking skills in Group A, Group B, and Group C with medium category. The difference in creative thinking skill scores of students for each indicator before and after learning can be seen in Figure 2.

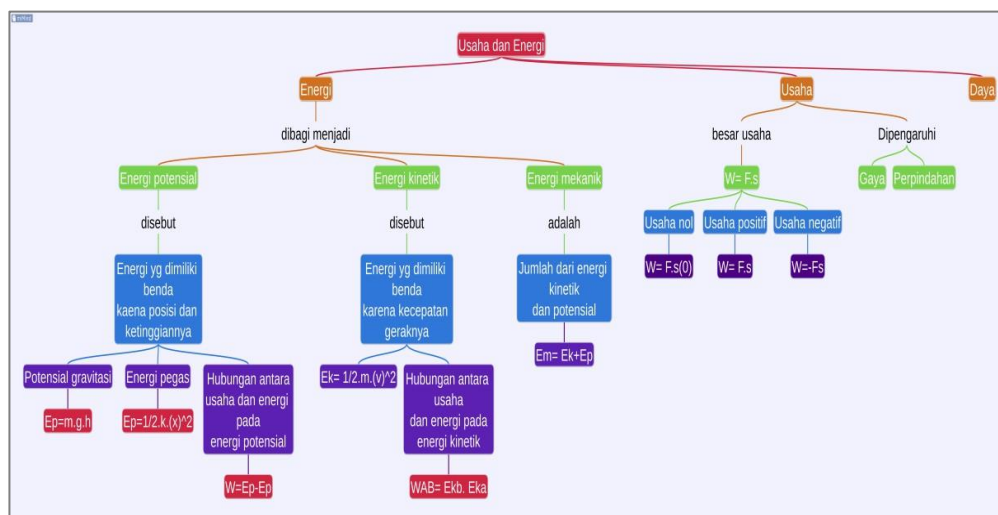


**Figure 2.** Graph of Creative Thinking Skills Score of Students for each Indicator Before and After Learning

The detail and originality indicators have the highest improvement scores compared to other indicators. This is because during the learning of the Concept Attainment Model (CAM) concept with the concept mapping technique, students are given the freedom to create concept maps with many branches and appropriate keywords. The freedom to express these ideas allows students to create detailed concept maps. In addition, students have various templates that can be selected on the mi-Mind application. Students are free to choose the shape of the concept map and color combination so that the concept map is made according to each student's imagination. The fluency and flexibility indicators experienced a lower increase compared to other indicators. This is in line with the results of research conducted by Handayani (2023) that the fluency and flexibility indicators had the lowest increase compared to other indicators. This is because students are not used to making concept maps. Students are confused about determining and placing concepts in the right order so that there are several concepts that are missing at the concept map level. In addition, students are also confused about making conjunctions. Most students use inappropriate conjunctions. Based on Tables 5, 6, and 7, it is known that students experienced an increase from the less creative category to very creative. Figure 3 shows the concept map created by student 26 during the pretest. While Figure 4 shows the concept map created by student 26 during the posttest.



**Figure 3.** Concept Map during Pretest



**Figure 4.** Concept Map during Posttest

Based on Figure 3 and Figure 4, there are many developments in making concept maps. The concept maps that are made are more detailed, the concepts are in the correct order, have appropriate conjunctions, have many branches, colors according to each level, and are more interesting than the concept maps during the pretest. This shows that the learning material used is effective in improving creative thinking skills.

The application of the results of the development of the Concept Attainment Model (CAM) with the concept mapping technique can improve students' creative thinking skills. In this study, concept maps were made using an

application called mi-Mind. The use of concept maps in learning has been carried out by Alkilany, A. (2011). Based on his research, it can be concluded that the use of concept maps in learning has a positive effect on student creativity. Concept maps and creativity influence each other and provide many benefits for students and teachers. This is in line with research conducted by Suprpto, et al. (2021) that concept mapping and 3D representation are effective in improving student achievement and creativity. Zubaidah, et al (2018) have conducted research by collaborating the STAD learning model with concept mapping, and it can be concluded that students have higher critical and creative thinking skills compared to students who are taught with conventional learning. This is supported by Junaedi's opinion (2008), that concept mapping can increase students' creativity in determining concepts (Junaedi, 2008).

In addition, the increase in creative thinking skills is not optimal due to several things. Based on research conducted by Sunarto (2021), students' learning experience in making concept maps is still lacking. In addition, students also feel burdened to make concept maps because they have to study material that has been studied (Sunarto, 2021). Another obstacle in compiling concept maps was also mentioned by Septiana (2011) that students have difficulty in determining connecting words between one concept and another. Overall, the average increase in creative thinking skills of students in Group A, Group B, and Group C is in the medium category.

## CONCLUSIONS

The conclusion of this study is significant differences and improvements in creative thinking skills seen from the pretest and posttest scores obtained, the use of the Concept Attainment Model (CAM) learning materials with the concept mapping technique on creative thinking skills has a high effect (strong effect), and Concept Attainment Model (CAM) with the concept mapping technique can improve creative thinking skills in class with a medium category. Thus, the learning model with the concept mapping technique is said to be effective in terms of creative thinking skills in Group A, Group B, and Group C which experienced an average increase of 0.52 with a medium category.

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