



Cognitive Flexibility in terms of Mathematics Education Student Learning Outcomes

Hamdan Sugilar^{1*}, Ida Nuraida², Ganiyu Habeeb³

^{1,2} Department of Mathematics Education, UIN Sunan Gunung Djati Bandung, Indonesia

³ Al Azhar University Cairo, Egypt

Correspondence: ✉ hamdansugilar@uinsgd.ac.id

Article Info

Article History

Received: 06-10-2021

Revised: 28-05-2022

Accepted: 29-05-2022

Keywords:

Cognitive Flexibility;
Mathematics Education;
Student Learning
Outcomes

Abstract

Cognitive flexibility is the ability to think openly and solve problems from different perspectives. People who have good cognitive flexibility will be able to learn faster, solve problems more creatively, and adapt and respond to new situations more effectively. This research method is a quantitative method of measuring the ability of cognitive flexibility as measured by questions that meet the indicators of cognitive flexibility, with the object of research being the sixth-semester student of one of the universities in the city of Bandung. The instrument consists of cognitive flexibility questions, theories about cognitive flexibility, and questionnaires. Processing data by calculating the percentage of answering the questionnaire and cognitive flexibility test scores in complex analysis courses. The study results showed that the ability to think openly and many ideas and ideas about something was still low, and the two commands had a low correlation with lecture outcomes, so the ability to think openly and many concepts and ideas need to be improved so that students have an open mind and find new ideas in solving problems.

INTRODUCTION

The ability to find order among an ordered set of units is called a pattern. The regularity and strictness of the principles, structures, patterns, postulates, and theorems often distinguish mathematics from others. One of the mathematical abilities is the problem-solving ability to relate and use definitions, postulates, and theorems that have been proven previously to construct logical proofs [1], [2]. Each science has characteristics, epistemology, and studies that distinguish one science from another, including the competencies and skills acquired through studying that science. The skills required to face the demands of the times are increasingly complex, and only those who have the abilities according to their needs will survive in exploring this life. The skills needed have also shifted from 2020 to 2025, and of course, universities must respond quickly so that university graduates are ready and skilled to welcome 2025. One of the skills needed is Complex problem-solving, Critical thinking analysis, Creativity, originality, initiative, and flexibility. It is exciting why these two components are required in 2025 and need to be studied and prepared to achieve these skills. The increasingly competitive demands of 21st-century capabilities require four competencies, namely Critical Thinking and Problem Solving, Creativity and Innovation, Communication and Collaboration) [3], [4]. There is no close relationship between creative and critical thinking, but these two abilities need to be studied separately [5].

Cognitive flexibility refers to our disengagement from one task and responding to another or thinking through several concepts. A cognitively flexible person will be able to learn faster, solve problems more creatively, and adapt and react to new situations more effectively, which is why it is so vital in both educational and workplace environments to have cognitive flexibility. People with cognitive flexibility can solve problems constructively and continuously [6]. To respond and prepare someone to have good cognitive flexibility. It is necessary to have suitable instruments or tools in building cognitive flexibility due to the complexity of the existing problems so that by responding quickly to issues and immediately finding the best solutions needed today by being able to develop professionally and follow the work environment. which will continue to change in the future. Cognitive flexibility is related to critical and creative thinking because both are higher-order thinking skills, one of which is asking challenging questions, high-level problems, and inquiry-based experiments [7], [8].

The research results [9] stated that the mathematical reasoning ability of mathematics education students was in the range of 54.6 (low) on a rating scale of 100 with a standard deviation of 1.94. This value indicates that the mathematical reasoning ability of mathematics education students is in the poor category, thinking Students' logic and courage to try (trial and error) is still low. According to him, they are afraid of being wrong in expressing their ideas and ideas and are accustomed to routine problems. As a result, it is challenging to understand non-routine issues well. The concept of the prerequisite material is not well understood. These problems need to be adequately addressed by making students understand the accurate analysis material well through the development of cognitive flexibility skills. Students who already have the habit of flexible thinking will become people who think effectively [10]. Cognitive flexibility is shifting attention between two aspects of a stimulus and patterns. The greater the value of cognitive flexibility, the higher the individual's problem-solving ability [11]. The higher the mental flexibility, the higher the problem-focused coping [12]. From some of these studies, it can be concluded that having the ability to cognitive flexibility is needed, so it needs to be reviewed again in measuring cognitive flexibility abilities in complex analysis course materials or others. Current research examines the relationship between patterns, cognitive flexibility, and reading in first graders with the expectation that they will relate [13]. The purpose of this study is to determine the ability of cognitive flexibility in solving complex analytical problems, the relationship between cognitive flexibility and critical and creative thinking, and student attitudes towards cognitive flexibility abilities

METHOD

This study uses quantitative research to determine the correlation between cognitive flexibility abilities and learning outcomes, the relationship between critical and creative thinking abilities to cognitive flexibility abilities, and student attitudes towards cognitive flexibility abilities. The research object is a sixth-semester student of the University in Bandung who is studying complex analysis. Data processing using descriptive analysis and regression analysis tests cognitive flexibility ability on the results of difficult analysis lectures. The instruments used are four questions of cognitive flexibility, final grades for complex analysis courses, and questionnaires.

RESULTS AND DISCUSSION

1. Creative, Critical Thinking, and Its Relation to Cognitive Flexibility

Cognitive flexibility is an important characteristic that helps humans pursue complex tasks, such as multitasking and finding adaptable solutions to changing demands [14]. Yet it is still a poorly understood construct. After briefly reviewing some of the investigations of this construct in cognitive science, cognitive flexibility is a property of the cognitive system rather than cognitive skills. Flexibility can be thought of as belonging to a cognitive system, not a static structural entity. The emergence of mental flexibility is dependent on two types of interaction: the first involves the exchange of cognitive mechanisms; the second consists of the interaction of sensorimotor mechanisms, cognition, and the context in developmental time. Thus, flexibility appears as a dynamic property. This framework needs systematic empirical evidence. The inherited cognitive structure needs to be given a stimulus so that the construction can develop either in the form of assimilation or accommodation. Building an excellent cognitive system will produce good cognitive flexibility, flexible, not rigid.

To build cognitive flexibility suggests seven ways to do one, change your daily routine. Second, by providing a new experience. New and exciting experiences have also been shown to trigger the release of dopamine, which increases motivation and improves memory and learning. Third, practice creative thinking. Another way to build cognitive flexibility is to make an effort to think in unconventional and creative ways or to practice different thinking. Fourth, Do not always take the easy way. Research shows that introducing so-called "desired difficulties" can lead to deeper learning by not always choosing the easiest way. You can keep your mind sharp and even learn through your everyday experiences. Fifth, Go out of your way to meet new people sixth, Transfer your learning. Learning to transfer what you have learned in one context to a new context can be a great exercise in cognitive flexibility because it forces you to form new connections between previously unconnected knowledge networks and think more creatively. Without the ability to transfer skills and knowledge to new contexts, your learning will not have much impact. For example, one study found that although street children could perform complex mathematical calculations when selling their goods, they could not answer the same problems they presented in a school context. Seventh, challenge your morals. Research shows that seeking out experiences that test your morals and expose you to different beliefs, values, and expectations can better understand different cultural perspectives and help you become more flexible in your thinking.

Table 1. Skills Needed in 2020 and 2025

Skills needed in 2020	Skills needed in 2025
Complex Problem Solving	Analytical thinking and innovation;
Critical Thinking	Active learning and learning strategies;
Creativity	Complex problem-solving;
People Management	Critical thinking analysis;
Coordinating with Others	Creativity, originality, and initiative;
Emotional Intelligence	Leadership and social influence;
Judgment and Decision Making	Technology use, mentoring, and control;
Service Orientation	Technology design and programming;
Negotiation	Resilience, stress tolerance, and flexibility;
Cognitive Flexibility	Reasoning, problem-solving, and ideation

The year that will soon be welcomed is 2025. Of course, readiness is needed to build human resources ready to face it. Based on table 1. The significant difference lies in the ability of Critical Thinking and Creativity in 2020 to become Critical thinking analysis; Creativity, originality, and initiative. Of course, the scope is always comprehensive. All these skills need to be prepared carefully regarding the design of the suitable device in the form of a model or instrument that encourages these skills, the accuracy of setting goals, and implementation to evaluate the achievement of these skills. In 2020, two things in the spotlight were emotional intelligence and cognitive flexibility, which will no longer exist in 2025 [15]. This is broader in scope into reasoning, problem-solving, and ideation. In resilience, stress tolerance is related to attitude, while flexibility is related to one's cognitive perspective in building a flexible attitude in dealing with the complexity of problems to be ready to face various issues. One of these efforts is by learning HOTS.

Perspectives on the relationship between critical and creative thinking are different, but both have intersections: elaboration, complexity, synthesis, integration, combination, abstraction, and care for the environment. The dynamic interaction approach argues that critical and creative thinking share many behaviors and work throughout problem-solving, but some dominate others at specific stages.

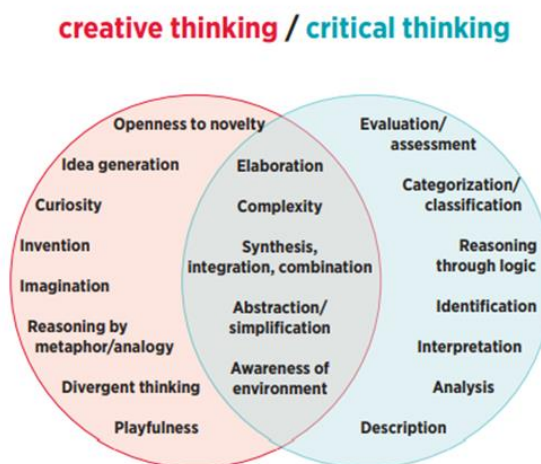


Figure 1. The relationship between creative thinking and the Critical Thinking [16]

The ability to analyze problems or synthesize that students have always given birth to cognitive flexibility so that they can quickly and quickly solve the problem. Of course, this problem will be an obstacle during lectures for both lecturers and students. The strictness of these principles, facts, principles, and procedures will always build students' cognitive flexibility skills. They will construct based on their previously owned cognitive system. In this actual analysis course, these skills are expected to be able to build new thinking constructions. Cognitive flexibility forms the core of humans' extraordinary ability to adapt, but the precise neural mechanisms underlying our ability to move agilely between task sets are poorly understood [17]. For example, when students work on problems with different contexts, they are often confused. If they match the model, they can solve it smoothly. Students who showed flexibility in strategy between tasks were more successful than students who persisted with the same approach [18]. So particular strategies and other objectives are needed from learning accurate analysis through the development of HOST questions (analysis and synthesis), so there is a new experience in studying the material.

2. Ability Cognitive Flexibility

Table 2. Student Cognitive Flexibility Test Questions in Complex Analysis Course

No.	Indicator	Example
1	Open minded	Let $z_1 = x_1 + iy_1$, $z_2 = x_2 + iy_2$, dan $z_3 = x_3 + iy_3$. Substitution $(x_1, x_2, x_3, y_1, y_2, y_3)$ with integer members. Define a. $(z_1 + z_2) \cdot z_3$ b. $\frac{(z_1 + z_2)}{z_3}$
2	Lots of ideas and ideas about a thing	a. Find all z values that satisfy $e^z = ci$ b. Find all z values that satisfy $e^z = c - 1$
3	Changing the individual point of view or thinking when getting something new	If $f(z) = z^2 + 2z + 2i$, $g(z) = \bar{z} + 1$. Determine whether $(g \circ f)(z)$ is defined and write down the rules!
4	Using various troubleshooting methods to solve a problem	Proof that: a. $\sin(z_1 + z_2) = \sin z_1 \cos z_2 + \cos z_1 \sin z_2$ b. $\cos(z_1 + z_2) = \cos z_1 \cos z_2 - \sin z_1 \sin z_2$ c. Use the definition of a complex function to write $\sin \pi$ in the form of $A + iB$

Based on table 2, the questions presented in the table have instructions for solving them: do the questions according to your student id number (SID), for SID with odd endings, and work on the questions (1a, 2a, 3, 4a, and 5). For SID with even conclusions, work on the questions (1b, 2b, 3, 4b, and 5) provided sequentially with a maximum total score of 70. This guide is used to avoid cheating answers. Of course, this is not desirable, so through the questions given being very flexible, you will get objective results, especially in a pandemic atmosphere where the exam is conducted online through the known application.

The results of Cognitive Flexibility of 112 students through tests of cognitive flexibility. As follows:

Table 3. Student Cognitive Flexibility Test Results in Complex Analysis Course

No	Indicator	Max. Score	Average	Standard deviation
1.	Open minded	10	4.4	1
2.	Lots of ideas and ideas about a thing	10	4.5	1.76
3.	Changing the individual point of view or thinking when getting something new	10	8	3
4.	Using various troubleshooting methods to solve a problem	20	17	5.6

The cognitive flexibility test consists of four description questions with four indicators, so one question consists of one arrow. The questions given have gone through a contract validity test by expert evaluation lecturers. There are notes on the validity test results, one of which is that the questions given must focus on each indicator. Based on the table, the hands of open thinking and many ideas and ideas about something are still lacking, with a score below 5. This shows that cognitive flexibility in both indicators is still low. This is because students tend to be able to work on questions whose examples are already available and when new or non-routine questions often experience errors. If students understand the concept well, this will not happen, so it can be concluded that the ability of cognitive flexibility is still low, thinking they are still stiff and lack the confidence to try new things on multi-answer problems or multi-way answers. The use of non-routine problem solving processes plays a vital role in the significant correlation between creative thinking and critical thinking skills of students [19].

Based on the correlation test results between the variable x (cognitive flexibility indicator) and the results of the complex analysis course (y), as follows. The correlation between variable x_1 (open-minded) and variable y (outcome of complex analysis lectures) of 0.103 can be concluded that the correlation is very low. The correlation between x_2 (many ideas and ideas about a thing) and variable y of 0.343 can be interpreted that the correlation is low, x_3 (changing individual points of view or thoughts when getting new things) with a variable y of 0.467, it can be concluded that the correlation is in the sufficient category, and x_4 (using various problem-solving methods to solve a problem) with a variable y of 0.536 in the category of sufficient correlation. Furthermore, the significance of each correlation is as follows: 0.000, 0.000, and 0.000 all are less than 0.05. Because the four indicators are $0.000 < 0.05$ and thus the correlation between the two variables is significant.

The correlation value of each indicator variable x to variable y is obtained as follows: x_1 to learning outcomes (y) of $0.103 \times 100 \% = 10.30 \%$. This means that the correlation x_1 on learning outcomes (y) is 10.30% which can be interpreted as a very low correlation. x_2 on learning outcomes (y) of $0.343 \times 100 \% = 34.30 \%$. This means that the correlation x_2 on learning outcomes (y) is 34.30% which can be interpreted as a low correlation.

The correlation between the variable x_3 on learning outcomes (y) is $0.467 \times 100 \% = 46.70 \%$. This means that the correlation x_3 to learning outcomes (y) is 46.70% which can be interpreted as a low correlation. x_4 to learning outcomes (y) of $0.536 \times 100 \% = 53.60 \%$. This means that the correlation of x_4 to learning outcomes (y) is 53.60%, which means the correlation is sufficient. Based on the interpretation of each of these variables, it can be concluded that only x_4 on learning outcomes (y) shows a correlation with good category. The correlation coefficient only measures

the strength of the linear relationship and not the non-linear relationship. This is not a benchmark that cognitive flexibility has nothing to do with learning outcomes. This evidence is a measure that each indicator has an influence even though the effect is still low, but cognitive flexibility abilities need to be improved so that students are not rigid in solving problems with only one answer or unable to do so solve issues in different cases. Of course, this ability can help solve complex problems immediately from the flexibility ability.

Table 4. Correlation of r squared between variable x (an indicator of cognitive flexibility) and variable y (complex analysis lecture results)

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.641 ^a	.411	.386	4.97531
a. Predictors: (Constant), x_1, x_2, x_3, x_4				
b. Dependent Variable: x_5				

The squared value of r can accurately measure the ratio/proportion, and this statistical value is called the Coefficient of Determination, r^2 . Thus, the coefficient of determination can be defined as a value that expresses the proportion of variance in y that can be explained by a linear relationship between the variables x and y . Based on the importance of R obtained a value of 0.641, this indicates that there is a correlation between variable x (an indicator of cognitive flexibility) x_1, x_2, x_3, x_4 with variable y (outcome of complex analysis lectures) of 0.615. $r^2=0.411$. It can be stated that the level of cognitive flexibility can explain 41.10 % of the variance of analytical lecture results. The rest, 58.90%, may be caused by other factors and errors from the experiment.

Table 5. Analysis of Variance Between Variable x (an Indicator of Cognitive Flexibility) and Variable y (Complex Analysis Lecture Results)

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1672.855	4	418.214	16.895	.000 ^b
	Residual	2401.106	97	24.754		
	Total	4073.961	101			
a. Dependent Variable: x_5						
b. Predictors: (Constant), x_1, x_2, x_3, x_4						

Furthermore, the significance of the regression equation was obtained by looking at the significance of the ANOVA table of $0.000 < 0.05$. The regression equation can predict cognitive flexibility variables and college outcomes. The coefficient of the regression equation for the variable x (an indicator of cognitive flexibility) and the variable y (the results of complex analysis lectures). The regression equation from the table is $y = 51.601 + 0.586x_1 + 0.833x_2 + 0.650x_3 + 0.504x_4$. To measure students' attitudes about cognitive flexibility abilities, students filled out a questionnaire via a google form. The results of the questionnaire distributed to 112 students who are taking complex analysis lectures obtained the following results:

Table 6. Results of the Cognitive Flexibility Questionnaire

No.	Indicator	Statement	SS	S	TS	STS
1	Open-minded	I accept different friends' solutions when discussing	17	64.77	15.96	2.27
2		About the problems in the material that I study.	7.95	69.32	21.59	1.14
3		I solve problems in the material I study under the coercion of the lecturer.	2.27	12.5	55.68	29.55
4		I consider conflicting proposals when discussing issues in the material I am studying.	14.77	72.73	10.23	2.27
5		I can't accept different opinions from friends if I don't prove it first.	9.09	55.68	27.27	7.96
6	Have a lot and ideas about a thing	I have ideas that can help me solve problems in the material I am studying.	7.95	69.32	21.59	1.14
7		If the problem given is complex, I only have one idea to solve it.	4.55	65.91	26.13	3.41
8		I constantly analyze the problems given from various sides to create a choice of solutions to solving them.	10.23	62.5	27.27	0
9		I refuse to change my ideas even though there is additional relevant information about my study material.	1.14	12.5	67.05	19.31
10		I can combine ideas from my friends to solve problems in the material I study	36.36	54.55	7.95	1.14
11	Individuals, when they get new things	When there are friends who are not used to having opinions and then providing new information, I will blame and act indifferent.	22.27	66.82	9.55	1.36
12		I dare to try new things when solving problems in my study material.	10.23	62.5	26.13	1.14
13		When new information is not understood, I try to avoid it.	2.27	21.59	57.95	18.19
14		I am enthusiastic when new information is given and try to understand it well.	18.18	67.05	12.5	2.27
15		I can immediately receive new information even though I don't know the truth.	61.82	26.14	1.14	10.9
16	Using various troubleshooting methods to solve a problem	If I can't solve a math problem, I look for many relevant sources to solve the problem.	42.05	48.86	4.54	4.55
17		I assume that one problem can be solved in one way only.	1.14	11.36	65.91	21.59
18		I can expand the new information provided so that the problem solving has multiple solutions.	11.36	48.86	36.36	3.42

No.	Indicator	Statement	SS	S	TS	STS
19.		If there is a problem with the material I study, I will be silent.	1.14	9.09	69.32	20.45
20		I am able to relate the material I have learned to	7.95	56.82	32.95	2.28
21		Sometimes I doubt the correctness of solving problems in the material I study if I use a different method.	21.59	64.77	11.36	2.28

Based on table 6, it is found that on the open-minded indicator, almost above 60%, in my statement I can't accept the opinion of a different friend if I don't prove it first, there is 27.27% who disagree, this means that he often gets views or answers without saying anything. try to rework. In the indicator, there are many ideas about a matter. One statement is that if the problem given is complex. I only have one picture to solve it there is 65.91% of students answered agree, meaning that students have difficulty developing ideas, and there is stiffness or lack of confidence in answering questions. in a different way. There are indicators of changing individual points of view or thoughts when they get new things. I can immediately receive further information in my statement even though I don't know the truth. There are 26.14% of students agree this means that students are accustomed to receiving answers from friends without checking first. This shows that the student lacks a fight in solving problems and uses various problem-solving methods to solve a problem, one of the statements is that I can develop new information provided, so that problem solving has many solutions there are 36.36% disagreed. It means the student is experiencing difficulty if the context of the question is changed to something new or has not been able to develop further information. This means that the student's flexibility is still low.

CONCLUSION

Students need the ability of cognitive flexibility to solve complex problems that will be faced. This ability can help solve various obstacles faced, namely by thinking openly, many ideas and ideas about a thing, changing individual points of view or thinking when getting new things, and using various problem-solving methods to solve a problem. The study results showed that the ability to think openly and many ideas and ideas about something was still low, and the correlation between the two towards lecture results was still down. This indicates that these two abilities must be improved considering that open thinking and lots of ideas are necessary for building non-rigid thinking so that if there is a problem, do not immediately give up but look for the right alternative solution.

REFERENCES

- [1] K. E. Lestari, "Analisis Kemampuan Berpikir Deduktif Aksiomatik Mahasiswa Menggunakan Teknik Probing-Prompting Pada Mata Kuliah Analisis Real Lanjut," *Lemma Lett Math Educ*, vol. 3, no. 1, pp. 20–30, 2016.
- [2] T. Masfingat, W. Murtafiah, and I. Krisdiana, "Kemampuan mahasiswa calon guru matematika dalam pemecahan masalah pembuktian teorema geometri," *J. Mercumatika J. Penelit. Mat. Dan Pendidik. Mat.*, vol. 2, no. 2, pp. 41–50, 2018.

- [3] S. Kurniawan, "Tantangan Abad 21 bagi Madrasah di Indonesia," *Intizar*, vol. 25, no. 1, pp. 55–68, 2019.
- [4] M. Muhali, "Pembelajaran Inovatif Abad Ke-21," *J. Penelit. Dan Pengkaji. Ilmu Pendidik. E-Saintika*, vol. 3, no. 2, pp. 25–50, 2019.
- [5] M. Baker, R. Rudd, and C. Pomeroy, "Relationships between critical and creative thinking," *J. South. Agric. Educ. Res.*, vol. 51, no. 1, pp. 173–188, 2001.
- [6] E. Hanife, "The relationship between pre-service teachers' cognitive flexibility and interpersonal problem solving skills," *Eurasian J. Educ. Res.*, vol. 18, no. 77, pp. 105–128, 2018.
- [7] B. Miri, B.-C. David, and Z. Uri, "Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking," *Res. Sci. Educ.*, vol. 37, no. 4, pp. 353–369, 2007.
- [8] W. Shim and K. Walczak, "The Impact of Faculty Teaching Practices on the Development of Students' Critical Thinking Skills," *Int. J. Teach. Learn. High. Educ.*, vol. 24, no. 1, pp. 16–30, 2012.
- [9] H. Sugilar, "Daya matematis mahasiswa program studi pendidikan matematika," *JNPM J. Nas. Pendidik. Mat.*, vol. 1, no. 1, pp. 97–108, 2017.
- [10] A. Aprianto, H. Praherdhiono, and A. Wedi, "Pengaruh Pembelajaran Berbasis Masalah dengan Penguatan Keterampilan Fleksibilitas terhadap Hasil Belajar Kognitif," *Edcomtech J. Kaji. Teknol. Pendidik.*, vol. 6, no. 2, pp. 264–274, 2021.
- [11] N. N. Oktaviani, P. K. Suprpto, and R. F. Mustofa, "Hubungan Antara Fleksibilitas Kognitif Dengan Keterampilan Pemecahan Masalah Pada Mata Pelajaran Biologi Di MAN Kota Tasikmalaya," *J. Bioterdidik*, vol. 9, no. 1, 2020.
- [12] E. O. Santosa and I. Setyawan, "Hubungan antara fleksibilitas kognitif dengan problem focused coping pada mahasiswa fast-track universitas diponegoro," *J. EMPATI*, vol. 3, no. 2, pp. 139–146, 2014.
- [13] D. Kim, D.-J. Kim, and W.-H. Whang, "Cognitive Synergy in Multimedia Learning," *Int. Educ. Stud.*, vol. 6, no. 4, pp. 76–84, 2013.
- [14] Ionescu, T. (2012). Exploring the nature of cognitive flexibility. *New ideas in psychology*, 30(2), 190-200.
- [15] S. M. Sevima, "10 Tops Skills Paling dibutuhkan di Tahun 2025 Menurut Kemendikbud Dikti," *10 Tops Skills Paling dibutuhkan di Tahun 2025 Menurut Kemendikbud Dikti*, 2021. <https://sevima.com/10-tops-skills-paling-dibutuhkan-di-tahun-2025-menurut-kemendikbud-dikti/>
- [16] Five College of Ohio and Teagle Foundation. (2012). "Creative and critical thinking: Assessing the foundation of a liberal arts education". Retrieved from <http://www.3.wooster.edu/teagle/creativity.php>.
- [17] L. Qiao, L. Zhang, A. Chen, and T. Egner, "Dynamic trial-by-trial recoding of task-set representations in the frontoparietal cortex mediates behavioral flexibility," *J. Neurosci.*, vol. 37, no. 45, pp. 11037–11050, 2017.
- [18] I. Elia, M. van den Heuvel-Panhuizen, and A. Kolovou, "Exploring strategy use and strategy flexibility in non-routine problem solving by primary school high achievers in mathematics," *ZDM*, vol. 41, no. 5, pp. 605–618, 2009.
- [19] Ülger, K. A. N. İ. (2016). "The relationship between creative thinking and critical thinking skills of students". *Hacettepe Universitesi Egitim Fakultesi Dergisi-Hacettepe University Journal of Education*, 31.