

## Student's Cognitive Conflict in Geometry Learning

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### ABSTRACT

Conflicts that occur within students in solving geometry problems are a concern for lecturers in the classroom. This is due to the occurrence of conflicting concepts in the minds of students. These concepts can be studied from various points of view, but if students cannot integrate the various information it will cause conflict. This conflict is internal and is known as cognitive conflict. Lecturers can apply appropriate learning strategies when they know the cognitive conflicts that occur in students. This study aims to describe the cognitive conflicts of students in solving the equation of a circle. The research method used is descriptive qualitative. This study involved students who experienced cognitive conflict as a sample. The instruments used are tests and interviews. The results showed that there were eight forms of cognitive conflict that emerged when students completed the given questions. There is a tendency where students can determine the center and radius of a circle correctly but have difficulty drawing a circle from the given equation.

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## 1. INTRODUCTION

Lecturers as educational facilitators need to identify problems regarding student understanding in higher education, especially in the Department of Mathematics. The goal is that the quality of the learning process in the classroom can be improved. The effort that can be done is to examine students' understanding of a certain mathematical concept as knowledge resulting from information processing. A concept can be studied from various points of view, but if students cannot integrate the various information it will cause conflict. The information that is not integrated causes a 'interference' in understanding the concept. In other words, there has been a state of mental imbalance in the understanding of mathematical concepts that have been studied by students. This contradicting or not integrating understandings of a mathematical concept is a condition commonly referred to as cognitive conflict.

Hiebert & Carpenter stated that a student will understand mathematics if the mental representation of the concept is part of the internal framework.(Carpenter et al., 1994) The internal framework referred to is what Piaget called the schemata in the cognitive structure. This is also in line with the opinion of Anderson & Krathwohl (2001) defining the meaning of understanding which is associated with cognitive processes.(Anderson et al., 2001)

Lecturer may not know how a student represents mathematical concepts internally when internal representation relations are built into a knowledge network as an internal structure. Meanwhile, the way students solve problems according to Hiebert and Carpenter is influenced by external representations, which can be in the form of images, symbols, and the others related to the problem being solved. Problem solving affects the internal representation and encourages the formation of a network for the internal representation. Internal representation is needed in thinking about mathematical ideas.

On the other hand, the definition of understanding according to Skemp notices that even though students do not understand a concept, they can think about how they can have an understanding of the concept. However, if these understandings are not in accordance with the actual concepts that have been previously understood, then these understandings have the potential to cause mental imbalances in their thinking processes due to conflicts between their understandings. In other words, understanding the concept is a person's mental condition that describes cognitive schemata that have absorbed information or knowledge which is characterized by a person's ability to carry out cognitive processes of interpreting, calculating, classifying, reasoning, comparing, proving, and explaining both orally and in writing when completing a problem.

Within the framework of the ongoing curriculum, it is already implied that students are required to learn with understanding, but the steps have not been explained in detail. This is as explained by Andreas and Gabriel: "although the vision of students learning mathematics with understanding has often appeared in curriculum frameworks, this vision has tended to be poorly described, thereby offering limited support to curriculum development and policy."

This is added if there is a conflict between the two knowledge schemas in the cognitive structure of inconsistency or conflict with each other which causes cognitive conflict. On the other hand, Ernest (1991) explains about cognitive conflict, namely: "...cognitive conflict, which occurs when there is conflict between two schemas, due to inconsistency or conflicting outcomes". Two knowledge schemas that do not integrate with each other. For example, students may experience cognitive conflicts in their understanding of the meaning of limit notation which does not integrate with their understanding of the formal definition of limit, because the student cannot explain the meaning of limit notation into a formal definition of limit or vice versa.

Piaget (Ernest, 1991) has introduced cognitive conflict as a state of mental imbalance in thinking. The imbalance that occurs in the schemata system occurs due to conflicts in thinking. Knowledge schemas stored in a person's memory or brain are understandings that are not integrated with each other or are a state of cognitive conflict. Recognizing the imbalance is personal, only the individual concerned is aware of the cognitive conflict experienced. However, this cognitive conflict can be raised by other people or teachers if they are faced with information that is different from what they understand.

Fanny (2018) states that cognitive conflict is a conflict between a person's cognitive structure and their environment. (Fanny Adibah, 2018) Moreover, Kwon & Lee (2001) define cognitive conflict as a conflict that occurs between the cognitive structure and the environment or between conceptions in the cognitive structure. (Lee & Kwon, 2001) In addition, cognitive conflict can be said as a person's understanding of a concept that is not integrated or contradictory and shows as a state of mental imbalance in the conflicting understanding. Several previous studies stated that research on cognitive conflict needs to be. (Haryono, Aini, Samsudin, & Siahaan, 2021) In addition, cognitive conflict is also a consideration in designing scaffolding for students. (Maharani & Subanji, 2018)

Bodrakova (1988) has explained the causes of cognitive conflict, namely "cognitive disequilibrium or conflict induced by awareness of contradictory discrepant information". (Bodrakova, 1988) According to him, cognitive imbalance or conflict is caused by awareness of contradictory or contradictory illogical information. Cognitive conflict can also occur when a person's expectations and predictions do not match each other. The limits of cognitive conflict described by experts above refer to a state of mental imbalance (disequilibrium) at the time of cognitive conflict.

Cognitive conflicts often occur among students because of misconceptions. (A'yun & Suyono, 2020) Cognitive conflict of mathematics in college can occur in certain materials. (Sari, 2020) One of them is about the equation of a circle. This material is discussed in Analytical Geometry of Planes and Spaces (AGPS) course which is given in the second semester. As a basic concept in Geometry, an understanding of the circle is needed to build an understanding of other Geometry concepts, such as parabola, ellipse and others. Basically, the student has acquired preliminary knowledge about circles in high school.

The transition period of learning about the circle from high school mathematics to college mathematics also has the potential to cause cognitive conflicts for students. Students assume that the circle studied in high school is about how to calculate the equation of a circle analytically. Meanwhile, when studying circles in college is how to draw a circle and discover the formula for the equation of a circle. To build a good student understanding of circles without causing cognitive conflicts, they are required to link their understanding of the procedure for calculating circles, understanding the geometric meaning of circles, and understanding the discovery of general forms of circle equations.

Secondly, lecturers can find out where the incomplete understanding of the concepts possessed by students is the cause of cognitive conflicts. This knowledge will provide information to the lecturer about the characteristics of the mental imbalance that students have in the conflict situation, whether the students are aware of the conflict they are experiencing, or have tried to overcome the conflict they are experiencing, or even if the students are in a situation of anxiety or pressure related to the conflict they are experiencing. After knowing how the conflict experienced by students, the lecturer can develop a lesson to overcome cognitive conflict. For instance, they apply scaffolding based on this in the classroom.

Thirdly, lecturers can use cognitive conflict as a learning strategy that aims to make students understand well about the circle concept that is taught to them. Lecturers must be able to identify students' understandings that have the potential to not integrate with each other and then develop them in learning as a complete knowledge construction, providing assistance, guidance, and instructional steps so that students can understand the real circle concept without experiencing cognitive conflicts.

Overall, it is necessary to conduct a study to uncover cognitive conflicts in geometry learning. Therefore, the research question is how students' cognitive conflicts in solving geometric problems. In this research, cognitive conflict is seen as internal, namely conflicts between conceptions or understandings in the cognitive structure. In other words, the understanding of the concept is not integrated or contradictory. In addition to knowing the form of cognitive conflict that will arise, it will also describe the factors that cause the emergence of cognitive conflict.

## 2. METHODS

The type of research is a qualitative research with exploratory descriptive method. The focus of this research is to find out how the form of cognitive conflict and its causes in students' understanding of the circle. This research is exploratory in nature with the reason that the main data of this study are words and the researcher explores students' understanding of the circle and then conducts an in-depth analysis in determining the forms of cognitive conflict in students' understanding of the circle concept. Exploration of students' cognitive conflicts in understanding the concept of a circle and its images was carried out on student completion in terms of calculating the center point and radius of the circle.

This research was carried out in the mathematics study program of IAIN Bukittinggi, namely the second semester students who were taking AGPS course as many as 31 people. The instruments used in this study were tests and interview guidelines. The researcher identified the cognitive conflict experienced based on the results of the test. The interview guide is used to find out the factors causing the conflict.

Before tests and interview guidelines were used to collect research data, these instruments were validated by experts to assess the content and construct validity of the test items. The validation of this instrument was carried out by 3 people who were considered experts in the field of geometry and

mathematics learning. For this reason, an instrument validation sheet was developed as a guide for assessment by the validator. The result is valid with improvement. The test questions that have been validated can be seen below:

1. Gambarkan lingkaran:
  - a.  $x^2 + y^2 = 9$
  - b.  $(x + 1)^2 + (y - 3)^2 = 58$
  - c.  $x^2 + 5y^2 - 2x + 4y + 1 = 0$
2. Tentukan titik pusat dan jari-jari lingkaran dari:
  - a.  $x^2 + y^2 = 9$
  - b.  $(x + 1)^2 + (y - 3)^2 = 58$
  - c.  $x^2 + 5y^2 - 2x + 4y + 1 = 0$

The two questions above were given at different times, where the first question was given first and then the answer sheets were collected. After that, the second question was given a few minutes later. To see the validity of the test results, time triangulation is used.

Furthermore, the interviews in this study were structured interviews guided by interview guidelines that had been developed by researchers and validated by experts. This interview was conducted on selected research subjects, namely students who were determined to meet the criteria as students who experienced cognitive conflict based on the analysis of understanding data about the circle concept obtained from the results of the test.

The interviews conducted were to clarify the data obtained from the test results and data that had not been revealed in writing in the administration of the test, such as what factors caused cognitive conflicts. The interview guide refers to the type of cognitive conflict investigated in this study, which is internal which is a conflict between the subject's understandings in its cognitive structure, the characteristics of imbalances in cognitive conflict situations which are combined from the theory proposed by Lee, et.al (2003) and namely: (1) unconsciousness and awareness of conflict situations (Unrecognized and Recognized of Contradiction), (2) paying attention to conflict situations (Interest of contradictions), (3) experiencing anxiety in contradictions, and (4) reassessing and trying to resolve the conflict (Cognitive Reappraisal). (Lee et al., 2003) Investigation results Kwon, et.al. This becomes a reference in this study to identify the characteristics of students' mental imbalances when experiencing cognitive conflicts.

### 3. FINDINGS AND DISCUSSION

The main data of this research is descriptive qualitative data which is analyzed to answer research questions, how students' cognitive conflicts in solving geometric problems. The findings regarding the cognitive conflicts experienced by students in solving the equation of a circle are described below:

**Table 1. Students' cognitive conflict for question no. 1**

No	Name	The Result
1	Subject 1	In drawing a circle, the center and radius are correct. However, it cannot correctly determine the center point of the equation of the same circle. The center point depicted is not at the point (0,0)
2	Subject 2	Draws the circle incorrectly, but cannot correctly determine the radius of the circle in the equation of the same circle. The radius obtained is 3, but in drawing it is used as the center point (3,0)
3	Subject 3	The subject makes a right triangle inside the circle and puts the radius as the hypotenuse so that the circle is drawn incorrectly. While in the calculation determine the center point and the correct radius (cognitive conflict)
4	Subject 4	Draw a circle with a radius of three but the calculation is wrong.
5	Subject 5	Subject can correctly determine the radius of a circle, but cannot draw a circle with that radius

In general, in problem no 1, regarding the equation of a circle that has a center at (0,0). The forms of cognitive conflict that arise are:

1. Determine the wrong center point but draw a circle with the correct center point.(Subject 1)
2. Calculated the radius of the circle correctly but drew a circle with the wrong radius.(Subject 2 and Subject 5)
3. Calculating the center and radius of the circle is correct but drawing the circle is wrong. (Subject 3)
4. Calculating the radius of the circle is wrong but drawing the circle is correct. (Subject 4)

**Table 2. Students' cognitive conflict for question no. 2**

No	Name	The Result
1	Subject 6	The picture does not contain the equation of a circle that is described, but is able to correctly determine the center and radius of the circle.
2	Subject 7	The picture of circle is wrong, but can correctly determine the radius of the equation of a circle
3	Subject 8	The picture is wrong, but can correctly determine the radius of the equation of a circle
4	Subject 9	The image created does not match the center point obtained
5	Subject 10	The picture is wrong, because in determining the center point you don't pay attention to the sign, it's difficult to draw the radius of the circle that has been obtained
6	Subject 4	Image does not exist, but the radius calculation is correct
7	Subject 11	Calculate the center point of circle is correct but can't draw circle

In problem no 2, regarding the equation of a circle that has a center at (a, b). The forms of cognitive conflict obtained are:

1. Determined the center and radius correctly but did not draw a circle at all. (Subject 6)
2. Calculated the radius correctly but drew a circle with the wrong radius. (Subjects 7,8 and 10)

3. Determine the center point of the circle correctly but draw a circle with the wrong center point. (Subject 9)
4. Calculating the radius is correct but there is no circle image (Subject 4)
5. Calculating the center point is correct but the circle image is missing (Subject 11)

Table 3. Students' cognitive conflict for question no. 3

No	Name	The Result
1	Subject 12	Able to draw a circle with the radius obtained is correct, but not with the center point obtained
2	Subject 13	The circle drawn does not correspond to the center point obtained
3	Subject 10	Wrong circle drawing, Can determine the value of r correctly, but wrong in determining the center point because it does not pay attention to the sign.
4	Subject 11	Calculate the center point is correct but can't draw circle

In question no 2, regarding the equation of a circle in general form  $x^2 + y^2 + ax + by + c = 0$ . The forms of cognitive conflict obtained are:

1. Determined the center point correctly but drew a circle with the wrong center point. (Subject 12 and Subject 13)
2. Calculates the radius correctly but draws a circle with the wrong radius. (Subject 10)
3. Defines the center point correctly but does not draw a circle. (Subject 11)

Based on the data obtained, there are 13 of 31 students who experience cognitive conflict. Where three of them experienced conflict on two questions. Furthermore, the three research subjects were interviewed to find the factors that caused the conflict. In this case, it was found that cognitive conflicts occurred because of differences and mixed schemes owned by students in understanding geometric concepts such as the answers of the subjects below:

Tentukan titik pusat dan jari-jari dari:

a)  $x^2 + y^2 = 9$   
pusat = (0,0)

jari = jari  $\Rightarrow x^2 + y^2 = r^2$   
 $x^2 + y^2 = \sqrt{9}$        $r = (3)$   
 $x^2 + y^2 = 3^2$

Figure 1. Answer of Subject 3

Based on Figure 1 above, it can be seen that the subject was able to correctly determine the center point and the radius of the circle, but when asked to describe the circle the subject answered incorrectly. This can be seen in the image below:

$\Rightarrow$  a)  $x^2 + y^2 = 9$   
 $\sqrt{x^2 + y^2} = \sqrt{9}$   
 $x^2 + y^2 = 3^2$

Figure 2. Answer of Subject 3

Based on Figure 2. it can be seen that the subject defines  $r$  as the hypotenuse. This shows that there is a conflict in understanding the schema between  $r$  as the hypotenuse and  $r$  as the radius of the circle. Therefore, the subject understands  $r$  as a relationship related to the Pythagorean theorem, namely  $x^2 + y^2 = r^2$ . In addition, the subject is also not aware of the center point of the circle that is at the center  $(0,0)$ .

Research subjects who experience cognitive conflict show certain symptoms or signs. This is in accordance with the opinion of Stacey (2009) which states that someone who experiences cognitive conflict has signs or cues. (Stacey, Sonenberg, Nicholson, Bonch, & Steinle, 2003) Cognitive conflicts that occur in research subjects because they have preconceptions and experience strange situations. This is in line with the opinion of Fraser (2007), if there is no strangeness (anomaly), then there is no cognitive conflict. (Fraser, 2007) In addition, there are several other symptoms that indicate the occurrence of conflict: an interest in the given problem, for example, facial expressions that look serious, worries such as expressions that show confusion and doubts in responding. This is in accordance with the opinion of Lee & Kwon (2001). (Lee & Kwon, 2001)

Cognitive conflict is also influenced by prior subject understanding or prerequisite concepts. The circle material has also been studied in high school. It is common knowledge that many students have misconceptions in mastering this material. (Maulida, Mardiyana, & Pramudya, 2017) Subjects who did not experience cognitive conflict were able to draw correctly if they managed to calculate the radius and center point correctly and vice versa. Based on the results of the description above, in general it can be concluded that the forms of cognitive conflict that arise in solving the equation of the circle are:

1. Determining the center point is wrong but drawing a circle with the correct center point.
2. Determining the center point is correct but drawing a circle with the wrong center point.
3. Calculating the center point is correct but the circle image does not exist.
4. Calculating the radius of a circle is wrong but drawing a circle is correct.
5. Calculating the radius of a circle is correct but drawing a circle with the wrong radius.
6. Calculating the radius of a circle is correct but the circle image does not exist.
7. Calculating the center point and radius of a circle is correct but drawing a circle is wrong.
8. Calculating the center point and radius of a circle is correct but the circle image does not exist.

Based on the data above, there are several things that students tend to do. They are able to explain the coordinates of the center point and the length of the radius of a circle if they know the equation of a circle better than describing a circle with that equation. Many of them are confused because they don't know where to start drawing the circle which causes conflict. There are concepts missing or not so well integrated that they cannot explain the relationship between the radius of a circle and the center in terms of drawing a circle. Such conditions in students' understanding of the circle have the potential to be the cause of cognitive conflict.

This is in line with the research conducted by Mega and Rini (2019) regarding cognitive conflicts in the field of geometry as well, this also occurs because of the different schemas that students have in understanding geometric concepts where students use old schemes that are not in accordance with the new. (Budiarto & Setyaningsih, 2019) When students admit that there are situations that are not in line with their conceptions, they are interested and/or anxious to resolve the oddities they experience. (Widadah, 2017)

#### 4. CONCLUSION

Based on the description above, there are eight types of cognitive conflicts that arise when students solve problems of circular equations. The efforts that can be made to reduce the occurrence of cognitive conflicts at the student level are (1) by changing the existing scheme; (2) or create a new schema so that the information obtained can be incorporated into the existing schema. (Budiarto & Setyaningsih, 2019) It is intended that students have a complete concept and understanding of students' concepts can increase.

Another alternative problem solving is to use cognitive conflict strategies in the learning process in the classroom (Verawati: 2020, Akmam: 2018, Kusuma:2019). (Verawati, 2020)(Akmam, Anshari, Amir,

Jalinus, & Amran, 2018)(Kusuma & Caesarani, 2019) Salamah also suspects that the learning model that can be used to improve the quality of the process and learning outcomes is the Problem-Based Learning model with cognitive conflict strategies.(Ningrum, 2019) In addition, research conducted by Mufit et al (2018) states that cognitive conflict has a positive effect on students' understanding of concepts in science learning.(Mufit, Festiyed, Fauzan, & Lufri, 2018) students' statistical thinking skills.(Susilawati, Abdullah, & Rosyidah, 2019) and students' critical thinking skills. (Muliadi, Prayogi, Mirawati, Azmi, & Verawati, 2019) The results of these studies underlie the authors to recommend the need for cognitive conflict as a strategy in learning to strengthen students' understanding of mathematics, especially in the field of geometry.

In addition, this research is expected to be continued in the future by looking at the benefits or effects caused by the presence of cognitive conflict and the discovery of learning syntax for cognitive conflict strategies, especially in the field of geometry.

## REFERENCES

- A'yun, K., & Suyono. (2020). *Uniqbu Journal Of Exact Sciences ( UJES ). Hubungan Tingkat Konflik Kognitif Terhadap Beban Miskonsepsi Mahasiswa Calon Guru Kimia, 1*(Agustus), 40–45.
- Akmam, A., Anshari, R., Amir, H., Jalinus, N., & Amran, A. (2018). Influence of Learning Strategy of Cognitive Conflict on Student Misconception in Computational Physics Course. *IOP Conference Series: Materials Science and Engineering*, 335(1). <https://doi.org/10.1088/1757-899X/335/1/012074>
- Anderson, L. W., Krathwohl Peter W Airasian, D. R., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., & Wittrock, M. C. (2001). *A Taxonomy for Learning, Teaching, and Assesing: A revision of Bloom's Taxonomy of Educational Objectives*. Retrieved from <https://www.uky.edu/~rsand1/china2018/texts/Anderson-Krathwohl - A taxonomy for learning teaching and assessing.pdf>
- Bordrakova, W. V. (1988). *The role of external and cognitive conflict in childrens conservation learning*. University of New York.
- Budiarto, M. T., & Setyaningsih, R. (2019). *Konflik Kognitif Mahasiswa Dalam Memahami Cognitive Conflict of Students in Understanding*. 2.
- Carpenter, T. P., Fennema, E., Fuson, K., Hiebert, J., Human, P., Murray, H., ... Wearna, D. (1994). *Teaching Mathematics for Learning with understanding in the Primary Grades*. <https://doi.org/R117G10002>
- Fanny Adibah. (2018). Penelusuran Konflik Kognitif Mahasiswa dalam Menyelesaikan Masalah Geometri Ditinjau dari Perbedaan Gaya Kognitif Field Dependent dan Field Independent. *Jurnal Widyaloka IKIP Widya Darma*, 5(2), 155–172.
- Fraser, D. (2007). Using cognitive conflict to promote a structural understanding of grade 11 algebra. *ProQuest Dissertations and Theses*, 174. Retrieved from [https://search.proquest.com/dissertations-theses/using-cognitive-conflict-promote-structural/docview/304720957/se-2?accountid=13042%0Ahttp://oxfordsfx.hosted.exlibrisgroup.com/oxford?url\\_ver=Z39.88-2004&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=](https://search.proquest.com/dissertations-theses/using-cognitive-conflict-promote-structural/docview/304720957/se-2?accountid=13042%0Ahttp://oxfordsfx.hosted.exlibrisgroup.com/oxford?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=)
- Haryono, H. E., Aini, K. N., Samsudin, A., & Siahaan, P. (2021). Reducing the students' misconceptions on the theory of heat through cognitive conflict instruction (CCI). *AIP Conference Proceedings*, 2330(March). <https://doi.org/10.1063/5.0043400>
- Kusuma, J. W., & Caesarani, S. (2019). Penerapan Pendekatan Konflik Kognitif terhadap Pemahaman Konsep Matematis Siswa di SMP Negeri 7 kota Serang. *Jurnal Ilmiah Pendidikan Matematika*, 4.
- Lee, G., & Kwon, J. (2001). What Do We Know about Students' Cognitive Conflict in Science Classroom: A Theoretical Model of Cognitive Conflict Process. *Proceedings of 2001 AETS Annual Meeting*, 309–325.
- Lee, G., Kwon, J., Park, S. S., Kim, J. W., Kwon, H. G., & Park, H. K. (2003). Development of an instrument for measuring cognitive conflict in secondary-level science classes. *Journal of Research in Science Teaching*, 40(6), 585–603. <https://doi.org/10.1002/tea.10099>

- Maharani, I. P., & Subanji, S. (2018). Scaffolding Based on Cognitive Conflict in Correcting the Students' Algebra Errors. *International Electronic Journal of Mathematics Education*, 13(2), 67–74. <https://doi.org/10.12973/iejme/2697>
- Maulida, F. O., Mardiyana, & Pramudya, I. (2017). Analisis Pemahaman Konsep Siswa Pada Materi Persamaan Lingkaran Ditinjau Dari Motivasi Belajar Siswa Kelas XII IPS 4 SMA Negeri 6 Surakarta Tahun Pelajaran 2016/2017. *Jurnal Pendidikan Matematika Dan Matematika*, 1(4), 26–45. Retrieved from <http://www.jurnal.fkip.uns.ac.id/index.php/matematika/article/view/11603/8303>
- Mufit, F., Festiyed, F., Fauzan, A., & Lufri, L. (2018). Impact of Learning Model Based on Cognitive Conflict toward Student's Conceptual Understanding. *IOP Conference Series: Materials Science and Engineering*, 335(1). <https://doi.org/10.1088/1757-899X/335/1/012072>
- Muliadi, A., Prayogi, S., Mirawati, B., Azmi, I., & Verawati, N. N. S. P. (2019). Efek Strategi Konflik Kognitif dalam Pembelajaran berbasis Model Inkuiri terhadap Kemampuan Berpikir Kritis Mahasiswa. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, 7(1), 60. <https://doi.org/10.33394/j-ps.v0i0.1442>
- Ningrum, S. S. (2019). *Strategi Konflik Kognitif dalam Pembelajaran Matematika*. (May). <https://doi.org/10.13140/RG.2.2.31304.78082>
- Sari, A. (2020). Profil Konflik Kognitif dengan Intervensi dalam Pemahaman Aljabar Mahasiswa Politani Pangkep. *Histogram: Jurnal Pendidikan Matematika*, 4(2), 545–564.
- Stacey, K., Sonenberg, E., Nicholson, A., Bonch, T., & Steinle, V. (2003). A Teaching of a Model Exploiting Cognitive Conflict. *Bayesian Network: University of Melbourne*, (June), 163–167. <https://doi.org/10.1007/3-540-44963-9>
- Susilawati, W., Abdullah, R., & Rosyidah, I. (2019). Peningkatan kemampuan berpikir statistis mahasiswa melalui challenge-based learning dengan strategi konflik kognitif. *Jurnal Analisa*, 5(1), 31–40. <https://doi.org/10.15575/ja.v5i1.4808>
- Verawati, N. N. S. P. (2020). Efek Penggunaan Strategi Konflik Kognitif Terhadap Hasil Belajar Kognitif Siswa. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, 4(2), 113–119. <https://doi.org/10.36312/jisip.v4i2.1242>
- Widadah, S. (2017). Konflik Kognitif Mahasiswa Calon Guru dalam Pembuktian Matematika. *Jurnal Edukasi*, 3(1), 146–151.

