Analysis of Inductive Reasoning Ability In Mathematics Learning Reviewed From Student Learning Independence

Elsa Komala [1a*], Erwan Setiawan 2[a] , Asep Saepuloh [3c], Trisnawati Riana Indari [4d]
[a*] Elsa Komala Suryakancana University, West Java, Indonesia, Email: elsakomala@gmail.com
[b] Erwan Setiawan, Suryakancana University, West Java, Indonesia, Email: erwan@unsur.ac.id
[c] Asep Saepulah, Suryakancana University, West Java, Indonesia, Email: asepsaepulah@unsur.ac.id
[d] Trisnawati Riana Indari, Suryakancana University, West Java, Indonesia, Email: trisnariana292@gmail.com

Abstract
This study purpose to determine the ability of inductive reasoning in mathematics learning, students' learning independence in mathematics learning, and the ability of inductive reasoning in mathematics learning viewed from the independence of students' learning. The method used is descriptive quantitative. The subjects in this study were 30 students from one class in one private junior high school in Cianjur using purposive sampling. The instruments used were inductive reasoning ability test questions and student learning independence questionnaires. Based on the results of the study, the following conclusions were obtained; students' inductive reasoning ability averaged 73% and was included in the moderate category. This is because students in inductive reasoning ability are quite able to meet the inductive reasoning indicators, although they are still less careful in finding the information given and asked; students' learning independence in mathematics learning averaged 63% and was included in the moderate category, this was because students were quite able to have aspects of learning independence, but had not been able to fully carry out activities that showed learning independence routinely; high learning independence was obtained by 8 students who had inductive reasoning ability in the moderate category. Students in moderate learning independence obtained 19 students who have moderate inductive reasoning abilities. Then students in the low learning independence category obtained 3 students who have moderate inductive reasoning abilities.

Keywords:
Inductive Reasoning Ability,
Mathematics Learning
Student Learning Independence,

1. Introduction

Mathematics is one of the basic subjects found in all levels of education. According to Wanti (2017) mathematics is a process of reasoning, character formation and mindset, formation of objective, honest, systematic, critical and creative attitudes and as a supporting science in drawing conclusions. Permendikbud Number 36 of 2018 states that the objectives of school mathematics learning for elementary and secondary education levels include so that students can use patterns as assumptions in solving problems, are able to make generalizations based on existing phenomena or data, use reasoning on properties, carry out mathematical manipulation both in simplification and analyzing components in problem solving, communicate ideas, reasoning and are able to compile mathematical evidence using complete sentences, symbols, tables, diagrams, or other media to clarify situations or problems.

According to the National Council of Teachers of Mathematica (NCTM, 2000) there are five standards of mathematical ability that students must have, namely problem-solving skills, reasoning skills, communication skills, connection skills, and representation skills. The statement shows that the development of students' reasoning abilities is one of the important goals that students must master in learning mathematics at school. Mathematical reasoning and mathematics learning are two things that are interrelated and cannot be separated, because mathematical material is understood through reasoning, then reasoning can be understood and practiced through learning mathematics (Romsih et al., 2019).

Mathematical reasoning ability is a person's ability to think logically to draw general or specific conclusions in the process of learning mathematics. With mathematical reasoning, students can put forward conjectures, then compile evidence and manipulate mathematical problems and draw conclusions correctly and precisely (Mikrayanti et al., 2019). Meanwhile, according to Sumartini (2015), mathematical reasoning is a thought process in determining whether a mathematical argument is true or false which is then used to create a new mathematical argument.

In general, mathematical reasoning can be grouped into two main parts, namely inductive and deductive reasoning (Kurnia Putri et al., 2019). According to Hidayah (2021), deductive reasoning is a person's thought process to draw conclusions from general things to specific things based on previous truths. Meanwhile, inductive reasoning according to Fajar (2004) is a thinking process that tries to connect facts or evidence using events or experiences that are often encountered (specific) and then concluded into general truths.

Inductive reasoning ability is one of the very important abilities and needs to be mastered by students in learning mathematics because inductive reasoning is useful for problem solving (Khoerunnisa et al., 2020). Meanwhile, according to Azizah (2019), inductive reasoning is an activity, a process or a thinking activity to draw conclusions or make a new statement of a general nature based on several specific statements that are known to be true. Inductive reasoning in mathematics is often found in various materials, one of which is in geometry material on determining the characteristics of a flat shape, in the material on sequences and series of numbers and proving the sum of the angles of a triangle is 180^0 (Novita, 2017).

According to The Organization For Economic Cooperation and Development (OECD, 2018), the low reasoning ability of Indonesian students is evidenced by the latest PISA score in 2018 which shows that Indonesia is ranked 72 out of 79 participating countries and Indonesia obtained a mathematics ability score of 379 which is far from the average of 489. Meanwhile, according to Fikriya (2018), Indonesian students are not yet accustomed to contextual questions whose solutions require students' ability to argue, reason, and be creative so that Indonesian students' mathematics achievements in the international arena are not yet satisfactory. In addition, most students have difficulty connecting existing knowledge to build new knowledge. Febriani & Rosyidi (2013) studied the inductive reasoning of junior high school students in solving sequence problems based on students' mathematical abilities and found that only high-ability students could carry out each stage that indicated reasoning and generalizing general forms.

In fact, in the field, students' inductive reasoning abilities are still lacking and have not developed optimally. This can be seen when researchers in the Introduction to School Environment (PLP) during the learning of arithmetic sequences and series for vocational high school students at a school in Cianjur, students still have difficulty understanding the questions so that they still make mistakes in determining the formula used, besides that students still cannot draw conclusions correctly in solving problems.The weakness of students' inductive reasoning abilities apart from internal factors that arise within the students themselves, one of which is in learning independence (Lessa et al., 2021). This can be seen when researchers in the Introduction to School Environment (PLP) for vocational high school students at a school in Cianjur in their learning independence is still lacking because most students still depend on others in completing assignments, many students still depend on teachers in terms of learning resources and most students also rely more often on the results of their friends' work during tests. This is in line with research by Uki & Ilham (2020) that many students experience learning achievement problems, because there is no initiative from within the students to learn independently, always depending on the teacher, if there is no teacher who enters the class to give lessons then there are no learning activities in the class and students just play.

Learning independence can be interpreted as the activeness of student learning which is based on the motivation within oneself to master competencies in a learning process with the aim of increasing student knowledge which will affect the achievements obtained by students in the learning process, students are not afraid to make a decision, students are able to be more active in interacting with peers and student self-control will be better (Putra et al., 2018). Fahradina (2014) emphasized that the main characteristic of independent learning is not the absence of teachers or fellow students, or the absence of face-to-face meetings in class, but rather the development of students' abilities to carry out learning processes that do not depend on factors such as teachers, friends, classes and others. With the help of

independent learning, students can develop their cognitive level, because students are accustomed to completing tasks and finding solutions to their problems by studying available sources and discussing and asking friends or teachers when they experience difficulties (Putra et al., 2017).

According to Isnaeni (2018), there are still many students who have poor reasoning skills, because learning independence is an obstacle so that the students' reasoning skills are not optimal. So that learning independence has a good influence on students' inductive reasoning skills. Regarding inductive reasoning skills, researchers emphasize inductive reasoning skills as reviewed from students' learning independence in mathematics learning. So the purpose of this study is to analyze inductive reasoning skills in mathematics learning as reviewed from students' learning independence..

2. Method

This research method uses a descriptive method with a quantitative approach, where this research is to reveal events or facts in analyzing inductive reasoning abilities in mathematics learning in terms of student learning independence. The subjects of this study were grade VIII students at one of the junior high schools in Cianjur in the even semester of the 2022/2023 academic year with a total of 30 students, using a purposive sampling technique with the consideration that the students had studied the number pattern material, students had sufficient learning experience so that they were expected to be able to solve questions on the number pattern material and students were able to communicate their thoughts in writing and orally.

This research instrument used inductive reasoning ability test questions on the number pattern material in the form of descriptions of 4 questions, and a student learning independence questionnaire using 9 indicators, the questionnaire was used to measure student learning independence by grouping according to high, medium and low categories. The data analysis technique used was based on the results of the test questions and questionnaires calculated based on the average results of the test questions and questionnaires for all students which were then categorized, the results of the students' answers were described using words

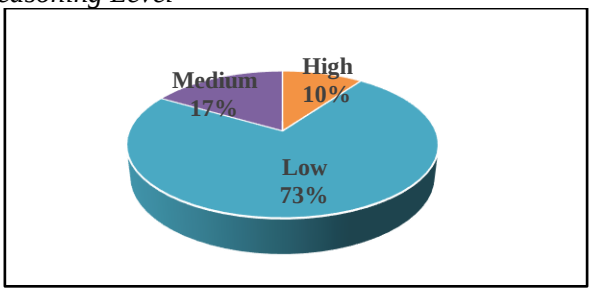
3. Results and Discussion

3.1 Inductive Reasoning Ability in Mathematics Learning

Based on the results of the percentage of the overall inductive reasoning level is at 73% with a moderate category. This means that students are quite capable of fulfilling inductive reasoning abilities. The following results of the percentage of students' overall inductive reasoning levels are presented in Figure 1 below:

Figure 1.

Percentage of Inductive Reasoning Level



The percentage of achievement of the inductive reasoning indicators as a whole can be seen in table 1. below

Table 1.

Percentage of Achievement of Inductive Reasoning Ability Indicators

Inductive Reasoning Ability Indicator	Percentage of Achievement Indicator	Category
Able to submit conjectures	64%	Medium
Able to perform mathematical manipulation	85%	High
Able to find patterns or properties to analyze mathematics	78%	High
Average	77%	Medium

Based on table 1. the highest overall percentage of achievement of the inductive reasoning ability indicator is the indicator of being able to carry out mathematical manipulation with a percentage value of 85%, meaning that students are able to solve mathematical problems using their own methods with the desired goals. In line with Ardhiyanti's research (2019) which states that only students with high and medium inductive reasoning abilities can meet the indicator of being able to carry out mathematical manipulation while students with low abilities are unable to carry out mathematical manipulation.

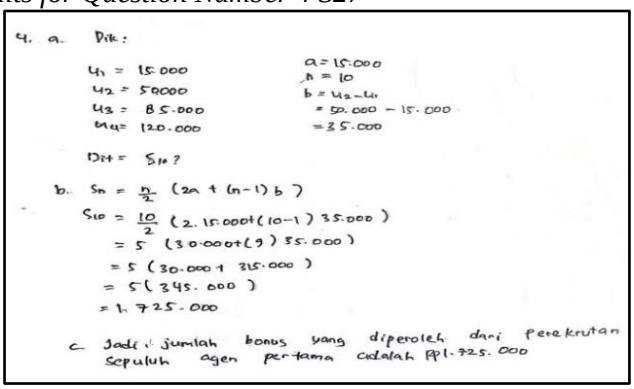
Based on the results of the average percentage of student answers from each indicator of 77%, so that students' inductive reasoning abilities are included in the moderate category. This means that students can make guesses quite well, are able to carry out mathematical manipulation well and are able to find patterns or properties to analyze mathematics well, although they are still not careful in finding the information given and asked. In contrast to the research of Lestari & Shodikin (2021) which shows that inductive reasoning abilities are in the low category, this is because students have not been able to explain the meaning of the problem completely, both the information given and asked in the question. However, students are able to compare the suitability of the information obtained with previously possessed knowledge.

Students' Inductive Reasoning Ability in the High Category

Based on the results of S27's answers, namely students whose inductive reasoning ability is in the high category. S27 when completing question number 1, in the first indicator was able to make a guess, where the student had written the information needed using pictures so that it was clear to understand and could write the questions correctly. Furthermore, in the second indicator the student used the solution and carried out the right manipulation in answering the question so that the student could solve the question correctly. In the third indicator the student was also able to write the conclusion correctly. S27 when completing questions number 2, number 3 and number 4 was able to make a guess but it was still incomplete because at the stage of writing what was known from the given question did not write the formula to find the difference value of the question. Furthermore, in the process of solving the question by using the arithmetic sequence formula correctly and writing the conclusion of the question correctly. The following are the results of s27's answers to question number 4 presented in figure 2.

Figure 2.

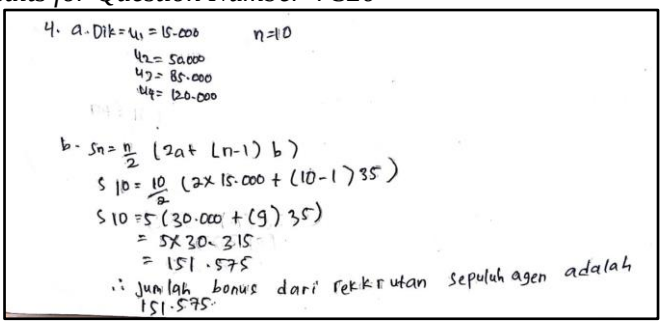
Example of Answer Results for Question Number 4 S27



Students' Mathematical Inductive Reasoning Ability in the Medium Category

Based on the results of S20's answers, namely students whose inductive reasoning ability is in the medium category. S20 when completing questions number 1, number 2 and number 3 when writing information from the questions is still incomplete, by not writing what is known from the information given by not writing the formula to find the difference value, but still able to solve the question correctly, this is shown when solving the question using the arithmetic sequence formula correctly and can write the final conclusion correctly. S20 in solving question number 4 is still incomplete in writing the information needed, where at the stage of writing what is known from the question does not write the formula to find the difference value, in the process of solving it is still not right because the calculation is still not right in the process of multiplying the values obtained so that this affects when writing the conclusion of the question which causes the final result to be incorrect. The following are the results of S20's answers to question number 4 presented in Figure 3.

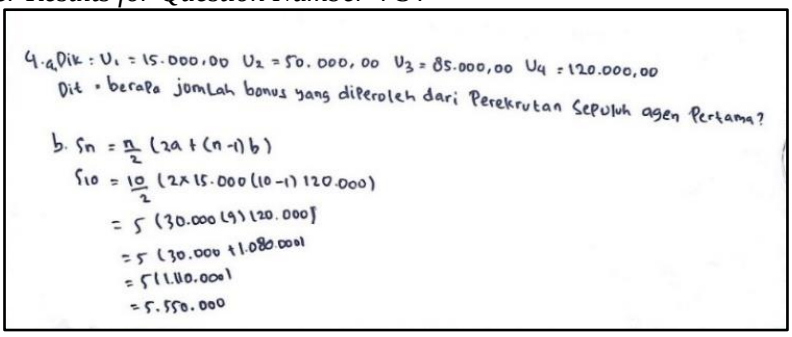
Figure 3.
Example of Answer Results for Question Number 4 S20



Students' Mathematical Inductive Reasoning Ability in the Low Category

Based on the results of S4's answers, namely students whose inductive reasoning ability is in the low category. S4 when completing questions number 1 and number 3 S4 is still incomplete in writing the information needed, where S4 does not write the formula and find the difference value but only writes the iron bar, does not write how many iron bars he knows and does not write the terms he knows. However, S4 is able to solve the problem by using the arithmetic sequence formula correctly and writes the conclusion of the problem correctly. While in solving problem number 2 S4 has been able to submit a complete conjecture by writing what is known and asked from the problem correctly and is also able to solve the problem using the arithmetic sequence formula correctly, but does not reach the final conclusion of the problem. S4 when completing question number 4 in writing the required information is still incomplete by not writing the formula and calculating the difference value, still not precise at the stage of completing the question where the calculation process carried out is still wrong and at the final stage does not write the conclusion of the question. The following are the results of S4's answers to question number 4 presented in Figure 4.

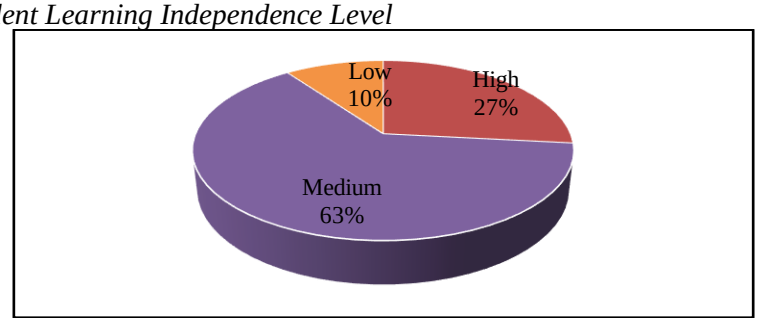
Figure 4.
Example of Answer Results for Question Number 4 S4



3.2 Student Learning Independence in Mathematics Learning

Based on the results of the overall student learning independence assessment category, it can be seen in Figure 5 below.

Figure 5.
Percentage of Student Learning Independence Level



Based on Figure 5. it is known that student learning independence in the highest category was obtained by 8 students with a percentage of 27%, in the medium category it was obtained by 19 students with a percentage of 63%, while in the low category it was obtained by 3 students with a percentage of 10%. Furthermore, the achievement of student learning independence based on its indicators is presented in the following table 2.

Table 2.
Percentage of Student Learning Independence Indicators

Learning Independence Indicator	Score	Percentage	Category
Self-study initiative	9,2	77%	Medium
Diagnosing learning needs	7,1	89%	High
Setting learning targets and goals	6,5	82%	High
Monitoring, organizing and controlling learning progress	4,9	61%	Medium
Viewing difficulties as challenges	6,2	77%	High
Utilizing and finding relevant sources	6,0	75%	Medium
Choosing and implementing learning strategies	6,6	83%	High
Evaluating learning processes and outcomes	9,6	80%	High
Having self-efficacy/self-concept	5,4	67%	Medium
Average	**6,8**	**77%**	**Medium**

Overall, the average percentage of student learning independence was 77% in the moderate category. This can be seen that students can meet the indicators of learning independence, where students are quite capable of having aspects of learning independence in the indicators of self-study initiative, monitoring, organizing and controlling learning progress, viewing difficulties as challenges, utilizing and seeking relevant sources, and having self-efficacy/self-concept, but have not been able to fully carry out activities that show learning independence routinely. In line with Suleang's research (2021) that student learning independence is still classified as moderate, so it needs to be improved. In addition, it can be seen from the indicators that have a high category where students can diagnose learning needs, which means that students learn independently so that students can choose the mathematics material that needs to be studied and students feel helped by the mathematics assignments given by the teacher. In line with Ambiyar's research (2020), the achievement of independence in the indicator of diagnosing learning needs is in the strong criteria with an average score of 73.12.

The ability of inductive reasoning in mathematics learning in terms of student learning independence is presented in the following table 3.

Table 3.
Categories of Inductive Reasoning in Mathematics Learning Reviewed from Student Learning Independence

No	Student Learning Independence Category	Number of Students	Average Inductive Reasoning Ability	Category
1	High	8	38,4	Medium
2	Medium	19	36,6	Medium
3	Low	3	33,6	Medium

The results of learning independence with a high category, there are 8 students with moderate inductive reasoning abilities. In contrast to Putri's (2017) research, students with high learning independence have good inductive reasoning abilities because they are able to work alone during learning, always try to do according to their abilities, and make the best use of their time. Then in learning independence with a moderate category, there are 19 students with inductive reasoning abilities in the moderate category. This is also in line with Latifa's (2022) research, subjects with a moderate learning independence category are only able to make guesses and carry out mathematical manipulations, but the subjects have not been able to draw conclusions from statements. While in learning independence with a low category, there are 3 students with moderate inductive reasoning abilities. In contrast to Lestari's (2021) research, students have low levels of learning independence, so their mathematical reasoning abilities are in the low category. There are several factors that influence

high learning independence and moderate learning independence is not in line with their inductive reasoning abilities, based on the results of students' inductive reasoning abilities, most are in the moderate category. This means that students who have moderate inductive reasoning abilities are quite good at making assumptions, are able to carry out mathematical manipulations well, and are able to find properties or patterns to analyze mathematics well, but are still less thorough in searching for the information given and asked.

4. Conclusion

Based on the results of the study, students' inductive reasoning abilities in mathematics learning as a whole are in the moderate category, where students are able to make predictions quite well, are able to manipulate mathematics well and are able to find patterns or properties to analyze mathematics well, although they are still less careful in finding information given and asked. Then, students' learning independence in mathematics learning as a whole is in the moderate category, this is because students are quite capable of having aspects of learning independence, but have not been able to fully carry out activities that show students' learning independence routinely and students are not so burdened and can choose the mathematics material that needs to be learned and students feel helped by the mathematics assignments given by the teacher. The results of inductive reasoning abilities in mathematics learning reviewed from students' learning independence show that students with high learning independence have moderate inductive reasoning abilities, where students are able to solve mathematics problems using their own methods or methods with the desired goals. Students with moderate and low learning independence have moderate inductive reasoning abilities, so that students' learning independence is not in line with their inductive reasoning abilities.

5. References

Ardhiyanti, E., Sutriyono, S., & Pratama, F. W. (2019). Deskripsi Kemampuan Penalaran Siswa Dalam Pemecahan Masalah Matematika Pada Materi Aritmatika Sosial. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *3*(1), 90–103.

Azizah, I. H. K. (2019). Analisis Kemampuan Penalaran Siswa dalam Pemecahan Masalah Matematika Siswa Kelas IV. *Indonesian Journal Of Educational Research and Review*, *2*(2), 1–7.

Fahradina, N., I., B., & Ansari, S. (2014). Peningkatan Kemampuan Komunikasi Matematis dan Kemandirian Belajar Siswa SMP dengan Menggunakan Model Investigasi Kelompok. *Jurnal Didaktik Matematika*, *1(2), 54-64.*

Fajar, S. (2004). *Pemecahan Masalah, Penalaran dan Komunikasi*. Yogyakarta: Pusat Pengembangan Penataran Guru Matematika.

Febriani, C., & Rosyidi, A. H. (2013). Identifikasi Penalaran Induktif Siswa dalam Memecahkan Masalah Matematika. *Mathedunesa*, *2*(1), 1–6.

Fikriya, A., Waluya, S. B., & Sunarmi. (2018). The Analysis of Adaptive Reasoning Ability Reviewed from Students' Confidence in Ethnomathematic-Based Treffinger Learning Model. *Unnes Journal of Mathematics Education*, *7*(1), 100–107.

Hidayah, N., Wibowo, T., & Purwoko, R. Y. (2021). Analisis Kemampuan Penalaran Deduktif Matematis Pada Calon Guru Matematika. *EKSAKTA: Jurnal Penelitian Dan Pembelajaran*, *6*, 57–61.

Isnaeni, S., Fajriyah, L., Risky, E. S., Purwasih, R., & Hidayat, W. (2018). Analisis Kemampuan Penalaran Matematis dan Kemandirian Belajar Siswa SMP pada Materi Persamaan Garis Lurus. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *2*(1), 107-115.

Khoerunnisa, S. N., Ratnaningsih, N., & Muslim, S. R. (2020). Analisis Kemampuan Penalaran Induktif Matematik Peserta Didik Ditinjau dari Gaya Belajar Silver dan Hanson. *Journal of Authentic Research on Mathematics Education (JARME)*, *2*(1), 67–78.

Kurnia Putri, D., Sulianto, J., & Azizah, M. (2019). Kemampuan Penalaran Matematis Ditinjau dari Kemampuan Pemecahan Masalah. *International Journal of Elementary Education*, *3*(3), 351-357.

Lessa, R., Kiki, E. S., & Cahya Mutiara Indah. (2021). Pengaruh Kemandirian Belajar Terhadap Kemampuan Penalaran Matematis Siswa SMP. *Arus Jurnal Pendidikan*, *1*(2), 35–40.

Lestari, A., & Shodikin, A. (2021). Profil Kemampuan Penalaran Induktif Siswa Ma Kebet Lamongan

Pada Materi Perpangkatan Dan Bentuk Akar. *Inspriramatika*, *7*(1), 27–33.

Mikrayanti, M., Baeti, N., & Wirahmat, I. (2019). Meningkatkan Kemampuan Komunikasi Matematis Melalui Pembelajaran Berbasis Masalah. *Supermat (Jurnal Pendidikan Matematika)*, *2*(1), 18–27.

NCTM. (2000). *Principles and standards for school mathematics*. USA: The National Council of Teacher Mathematics inc.

Novita, S. (2017). *Kemampuan Generalisasi Pola Matematis dengan Pendekatan Saintifik atau Observation Based Learning (OBL) Pada Siswa Kelas X Jasa Boga 1 SMKN Purworejo Materi Barisan dan Deret Tahun Ajaran 2016/2017*. [Tesis, Universitas Muhamadiyyah Purworejo].

OECD. (2018). *Programme for International Student Assessment (PISA) Result From PISA 2018*.

Permendikbud. (2018). Peraturan Menteri Pendidikan dan Kebudayaan Nomor 36 Tahun 2018 tentang Perubahan atas Peraturan Menteri Pendidikan dan Kebudayaan Nomor 59 Tahun 2014 tentang Kurikulum 2013 Sekolah Menengah Atas/Madrasah Aliyah. In *Permendikbud*.

Putra, I. I., Idkhan, A. M., & Djuanda. (2018). *Analisis Faktor yang Mempengaruhi Kemampuan Penalaran dan Dampaknya Pada Penguasaan Kompetensi Teknologi Mekanik Siswa SMK Se-Kota Makassar*. [Tesis, Universitas Negeri Makassar].

Putra, R. A., Kamil, M., & Pramudia, J. R. (2017). Penerapan Metode Pembelajaran Mandiri Dalam Meningkatkan Hasil Belajar Peserta Didik (Studi Pada Program Pendidikan Kesetaraan Paket C Di Pkbm Bina Mandiri Cipageran). *Jurnal Pendidikan Luar Sekolah*, *1*(1), 23–36.

Putri, E. B. (2017). *Analisis Kemampuan Penalaran Induktif Matematis Ditinjau Dari Kemandirian Belajar Siswa Melalui Model Problem Based Learning Brainstorming* [[Tesis, Universitas negeri Semarang].

Romsih, O., Yuhana, Y., & Nindiasari, H. (2019). Peningkatan Kemampuan Penalaran Matematis Siswa Melalui Problem Posing Ditinjau Dari Tahap Perkembangan Kognitif Siswa. *SJME (Supremum Journal of Mathematics Education)*, *3*(1), 37–46.

Suleang, F., Katili, N., & Zakiyah, S. (2021). Analisis Kemandirian Belajar Siswa Melalui Pembelajaran Daring Pada Mata Pelajaran Matematika. *Euler : Jurnal Ilmiah Matematika, Sains Dan Teknologi*, *8*(1), 29–35.

Sumartini, T. S. (2015). Peningkatan Kemampuan Penalaran Matematis Siswa Melalui Pembelajaran Berbasis Masalah. *Jurnal Pendidikan Matematika, 1-10.*

Uki, F., & Ilham, A. (2020). Pengaruh Kemandirian Belajar Siswa Terhadap Prestasi Belajar di SDN 03 Limboto Barat Kabupaten Gorontalo. *Aksara: Jurnal Ilmu Pendidikan Nonformal*, *6*(1), 89-95.

Wanti, N., Juariah, J., Farlina, E., Kariadinata, R., & Sugilar, H. (2017). Pembelajaran Induktif Pada Kemampuan Penalaran Matematis dan Self-Regulated Learning Siswa. *Jurnal Analisa*, *3*(1), 56-69.

Zuchri, A. (2021). *Metode Penelitian Kualitatif*. Gorontalo: Syaki Media Press.