Learning Obstacles of Students in One- Variable Linear Inequality: Systematic Literature Review (SLR)

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ABSTRACT
The following statement presents the findings of a systematic literature review, which aimed to categorize the challenges encountered by students when dealing with one-variable linear inequality material. These challenges were classified into three distinct criteria: mathematical ability, error analysis, and difficulty assessment. The analysis conducted in this study unveiled a significant correlation between student errors, misconceptions, and their underlying causes. Consequently, the research recommends enhancements in pedagogical approaches, informed by a comprehensive understanding of these errors, misconceptions, and their potential origins. Within the scope of the reviewed material, three primary types of learning obstacles were identified. First, the Ontogenic Obstacle stems from a transitional shift in students' cognitive development, as they transition from arithmetic thinking to grasping algebraic patterns. Second, the Epistemological Obstacle is attributed to the limited contextual understanding, leading to errors in problem-solving. Finally, the Didactical Obstacle arises from the employment of procedural teaching methods, which may hinder effective comprehension. It is essential to acknowledge the study's limitations, which encompass several aspects. These limitations include the reliance on data gathered primarily from search engines, a relatively small sample size comprising 16 qualitative studies, and a specific focus on the identification of student errors, difficulties, and mathematical abilities concerning the resolution of one-variable linear inequality problems. Despite these constraints, this research aspires to lay the groundwork for future investigations aimed at addressing these learning obstacles comprehensively. It is intended to serve as a valuable reference point for the improvement of subsequent research endeavors in this domain, ultimately contributing to the amelioration of the identified challenges faced by students.
Keywords: Learning Obstacle, One-variable linear inequality

1.   Introduction

The discipline of mathematics is very important role in life. Mathematics can be used systematically, creatively, honestly and disciplined to solve various problems. Apart from that, mathematics also has wide applications in various fields, such as the use of calculus in medicine, trigonometry in civil engineering, probability in economics, linear programming in management, combinatorics in programming, and algebra in the world of commerce, and many more. However, in practice in the classroom to achieve learning goals, learning obstacles are often found in mathematics learning. Learning Barriers are obstacles that students face when learning and result in the results of the learning being carried out not being optimal, (Sulastri et al., 2017). So, with learning obstacles, students have difficulty understanding basic concepts such as basic mathematical operations (addition, subtraction, multiplication, division), whole numbers, fractions, and other. This can hinder understanding of more complex material later on (Isnaini Indah Muthmainah et al., 2021). In achieving all these expectations, effective efforts are needed in the learning process as the main aspect carried out by students as learners with guidance from teachers as educators. It is hoped that teachers will be able to facilitate students to carry out an effective and meaningful learning process so that students' learning obstacles in understanding mathematical notation such as symbols, formulas and mathematical expressions which may be difficult for some students to understand can be avoided. This can make them feel confusing when reading or writing mathematics.

As an educator, the ability to analyze student learning barriers is one component that must be improved in teacher professional development. However, in situations it is often found that teachers experience misconceptions when working with linear and quadratic inequalities. These individuals make mistakes in solving linear inequalities, especially in representing solutions as intervals in

operations involving multiplication or division with negative numbers. (Biney et al., 2023).One-variable linear inequality material is important material in the junior high school mathematics curriculum where in this material students know and understand the concept of notation. algebra which is different from the previous one in the form of inequality signs. (Jupri et al., 2014). One-variable linear inequality is an open sentence that states the interaction of inequalities ($<$, $>$, $\leq$, $\geq$) containing one variableTaqiyuddin (2018).

One-variable linear inequalities are the main material studied at junior high school (SMP) level and are also one of the mathematics topics in junior high school which are contextual, so that students can learn them according to the context of everyday life. That way, linear inequalities in one variable should be able to be understood well without significant obstacles. In the material on linear inequalities in one variable, students need good skills because over time the application of the concept of linear inequalities in one variable has been widely used in various scientific disciplines. However, based on search engine results, it is clear that junior high school students' ability to understand and apply the concept of linear inequalities in one variable is still low, Taqiyuddin (2021)even in solving problems in the form of story problems J Yeti et al(2020).

Incomplete understanding of concepts will later create learning obstacles. In line with this, learning obstacles are categorized into three types, namely: *Ontogenic Obstacle* , namely a mismatch between the learning provided and the student's level of thinking, giving rise to difficulties in the process of understanding the material. If the level received by the student is too low, the student will not experience a real thinking process, on the contrary. if the level received by students is too high then students will experience difficulties and even not like mathematics because it is difficult, *Epistomological Obstacle* , namely difficulties in the learning process that occur as a result of limited context known to students, *Didactical Obstacle* , namely difficulties that occur as a result of learning carried out by the teacher S. Didi (2013). Therefore, the author feels it is necessary to conduct research using the systematic literature review method in analyzing students' learning obstacles in the material of one-variable linear inequalities. This research is of course still limited and does not fully describe student learning obstacles caused by students' errors, difficulties and mathematical abilities. However, it is hoped that this research can be an illustration for further research in improving or overcoming learning obstacles in single-variable linear inequality material.

2. Literature Review and Hypothesis

In the 17th century, the inequality symbol, more specifically "$<$ or $>$", was introduced for the first time by Thomas Harriot in his book Artis Analyticae Praxis ad Aeguationes resolven, Taqiyuddin (2018). However, the concept of inequality has of course been used by mathematicians for a long time, even without using the symbols we now use, for example in the study of geometry in the Euclid era. Furthermore, in the 18th century, inequalities became a separate discipline of study in the field of Mathematics, especially algebra, Jupri et al., (2014).

The essential concepts in the one-variable linear inequality material can be linked to the context of students' daily lives, but there are still various studies of students' learning barriers in this material. In the research, Anggoro & Prabawanto (2019) several respondents found errors in one-variable linear inequality material in answering questions, namely errors in determining what was known and asked about the question, creating a model, completing the model according to what was known from the question, and writing the final answer to the question in accordance with the question. Question requests, students even find it difficult to determine "and" or "or" in the context of the problem to obtain a solution.

3. Research and Method

This research uses a literature review method with the Systematic Literature Review (SLR) technique. Articles are obtained by searching research results using a search engine. This SLR research was carried out using the phenomenological method: identifying (binding), collecting data, identifying meaningful statements, giving meaning and making thick and rich descriptions. To complete this research, researchers collected journal articles on the Google Scholar and Scopus databases. The key words are barriers to student learning in the material of linear inequalities in one variable. The articles collected in this research are articles published in the period 2013 to 2023 with the aim of obtaining

updated data and an overview of research topics in accordance with current realities.

These articles are grouped by criteria based on year of study, ability criteria, error criteria, and difficulty criteria. The population of this research is all research, both quantitative and qualitative, on the abilities, errors and difficulties of junior high school students in the topic of linear inequalities in one variable which have been published in various scientific journal publishers. Based on. Searching using a search engine, a sample of 14 qualitative studies was obtained that were relevant in various methods and worthy of a more in-depth review. The data analysis technique in this research was carried out by grouping, analyzing and concluding data.

4. Result and Discussion

By applying inclusion criteria to all relevant studies, then categorized based on the year of research, learning barriers in the form of mathematical ability criteria, error criteria, and difficulty criteria. Descriptive data is presented in Table 1.

Table 1. Data based on research year

No	Year	Category		
		Ability	**Error**	**Difficulty**
1	2023	1		
2	2021	2	3	2
3	2020	1		1
4	2019		1	
5	2018	1		
6	2017		1	
7	2016			1
Amount		5	5	4

Based on Table 1, from 2016 to 2023 there were 5 studies regarding the mathematical abilities of high school students in solving one-variable linear inequality problems that have been published in various scientific journals. Then there were 5 studies about student errors and 4 studies about student difficulties. This shows that students still have obstacles in solving problems related to linear programming. Meanwhile, linear programming is a contextual problem that should be able to be understood well without significant obstacles

In 2023 there will be one article published, this could be due to the literature review analyzed in this research until 2023, so it is possible that this is because not all articles have studied barriers to learning in the material of linear inequalities in one variable. In 2022, no publications were found regarding junior high school students' errors in solving linear inequality problems with one variable, but in that year there was an increase in studies regarding student errors in other algebra material at the high school level, such as absolute value inequalities. However, the most research conducted in 2021 is about student errors in solving one-variable linear inequality problems. This illustrates that there are still obstacles in solving the problem of linear inequalities in one variable, which is illustrated by the large number of studies on this matter. Student errors and difficulties were identified based on the results of these studies. Of course, researchers must look for solutions and find out what causes the students' errors and difficulties.

5. Conclusion

From the results of research on the mathematical abilities of junior high school students in single-variable linear inequality problems the results obtained are presented in Table 2.

Table 2. Research on Junior High School Students' Mathematical Ability on Problems

No	Researcher. Year	Title	Sinta/ Proceedings	Journal Name	Research design	Research subject
1	Dhika Ayu Pratiwi1 & M Tohimin Apriyanto. 2021	Analysis of Mathematical Problem Solving Ability on Systems of Equations and Linear Inequalities in One Variable.	National Proceedings	Proceedings of the National Panel Discussion on Mathematics Education, Indraprasta University PGRI Jakarta	Qualitative	Class VII students at Pasarkemis Middle School
2	Yeti Jumiati and Luvy Sylviana Zanthy. 2020	Analysis of Student Errors in Solving Story Problems of Linear Equations and Inequalities in One Variable	Sinta 3	Journal of Innovative Mathematics Learning (JPMI)	Qualitative Descriptive	Class VIII students of Daarul Fikri Cimahi Integrated Islamic Middle School.
3	Restuningsih and Siti Khabibah. 2021	Analysis Of Student Errors In Solving Problems, Stories, Materials, Equations, And Linear Inequalities Of One Variable		CARTESIAN Journal of Mathematics Education	Descriptive Qualitative (Newman Analysis)	Scholler
4	Baiq Yuni Wahyuningsih	Analysis of Students' Understanding Difficulties in Learning Mathematics Material on One-Variable Linear Equations and Inequalities		MASALIQ Journal of Education and Science	Qualitative	
5	Siti Maryam Rohimah. 2017	Analysis of Learning Obstacles in One Variable Linear Equations and Inequalities		JPMM	Didactical Design Research	Class VIII Middle School and X-MIA High School Students.
6	Muhammad Taqiyuddin, Encum Sumiaty, Al Jupri. 2017	Misconceptions Of Junior High School Students On The Topic Of Linear Inequality Of One Variable			Qualitative	Class VIII Middle School students
7	Muhammad Taqiyuddin. 2021	Pre-Service Teachers' Operative And Figurative Actions: The Case Of One-Variable Inequality			Qualitative	

8	Muhammad Taqiyuddin. 2021	How Mathematical Inequality Topics Are Covered In Indonesian Secondary School Mathematics Textbooks				
9	Isnaini Indah Mutmainah, Nyiayu Fahriza Fuadiah and Putri Fitriasari. 2021	Learning Obstacles in Learning Linear Inequalities in One Variable in Class X High School Students		GAUSS: Journal of Mathematics Education	DDR	Class X student at Shailendra Palembang High School
10	Azizah, Iskandar Zulkarnain and Rizki Amalia. 2023	Development of Problem-Based LKPD with Wetland Environmental Context in One Variable Linear Inequalities		JURMADIKTA	Development	
11	Al Jupri & Paul Drijvers. 2014	Difficulties in Initial Algebra Learning in Indonesia	Sqopus	Frudental Institute		Class VII Students
12	Al Jupri & Paul Drijvers. 2016	Student Difficulties In Mathematizing Word Problems In Algebra	Sqopus	Eurasian Journal Of Mathematics, Science & Technology Education		
1 3	Samuel Kojo Biney, Clement Ayarebilla Ali and Nixon Saba Adzifome	Errors And Misconceptions In Solving Linear Inequalities In One Variable	International Journal	Journal Of Advanced Science And Mathematics Education		
14	Angelina Rocchio. 2020	Multiple Intelligences In The Mathematics Classroom: A Curriculum Project On Linear Equations And Inequalities In One Variable				
15	Nana Sepriyanti and Cisil Tapia. 2018	The Development Of Mathematics Comics Media On Linear Equations And Linear Inequalities Of One Variable		SHS Web Of Conferences		
16	Zulhendri, Z. Mawardi Effendi, Darmansyah. 2022	Analysis of Student's Error in Solving Linear Inequality		East Asian Journal of Multidisciplinary Research (EAJMR)	Descriptive Qualitative	

Based on Table 2, for students' difficulties in solving problems related to inequalities material, several things were identified, namely students experiencing difficulties in solving problems, Ayu, D et al., (2021)stating that their problem solving abilities were found to be 22.5% in the high category, 12.5% in the medium category and 65% in the medium category. low. Apart from problem solving abilities, there are also students' errors in understanding the concept, where the subject's error is not being able to understand the concept of variables, the subject not writing down examples and errors in translating the problem into a mathematical model. So, if conceptual errors are made automatically, principle errors and

operational errors will definitely be made and the problem cannot be analyzed further because the subject cannot write down the form of the equation so the problem cannot be solved correctly Jumiati et al., (2020). Zulhendri et al., (2022) adding that it is known that the types of student errors in solving one-variable linear inequality problems are: a) Conceptual errors making errors in graphical solutions, errors in using the concept of the variable to be used, identifying what is required, and choosing error symbols, and b) Procedural errors including : errors in choosing strategies to be used in solving problems, errors in applying strategies to solve problems, and errors in seeing whether the solution obtained is in accordance with what is known and requested. Likewise, research Wahyuningsih, B Y (2022) states that the errors obtained by students are caused by problems that occur when learning material about linear inequalities in one variable, namely: 1) Students do not understand that the following three inequalities are equivalent and 2) Students do not understand the meaning and notation/writing of the final result from the results obtained. Based on these results, students should be given meaningful learning so that they not only memorize formulas but can also solve linear inequalities. Mistakes that occur to students can also be due to teacher candidates lacking an understanding of basic rules, procedural fluency and skills, as well as the formulation of linear inequalities. These errors stem from misunderstood methods and rote memorization without understanding. Therefore, it is recommended that educators incorporate practical and everyday methodologies in the teaching and learning of linear inequalities, Biney et al., (2023)

From the results of the analysis, it was also found that there was a relationship between student errors, student misconceptions and possible causes. The researcher also suggests several things for learning PTLSV topics based on student errors, student misconceptions and possible causes. , Taqiyuddin & Jupri, (2017).According to the findings of this research, there are three types of learning difficulties faced by students in one-variable linear inequality material: Ontogenic Constraints, Epistemological Constraints, and Didactical Constraints, Muthmainah et al., (2021). Ontogenic obstacles are found because there is a leap in students' thinking from an arithmetic mindset to an algebraic mindset. Epistemological obstacles are found due to limited context for students which causes errors in working on questions. Didactical obstacles were found because the teacher's teaching was procedural so that the formation of the concept of linear equations and inequalities in one variable in students did not go well Rohimah, S (2017).

Based on this research, researchers hope that this research can be used as well as possible in an effort to minimize the occurrence of learning obstacles again. However, this does not absolutely apply globally. There are limitations to this research, including the limitations of researchers in collecting data only through search engines. The sample size of only 16 qualitative studies certainly cannot describe the real situation. The findings in this research also only identify students' errors, difficulties and mathematical abilities related to solving problems with one-variable linear inequalities. So it is hoped that the findings that have been obtained can become an initial basis for future researchers to find the right solution to minimize these obstacles. Thus, these things can certainly be a reference for future researchers so they can correct the shortcomings contained in this research.

6. Acknowledgement

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