

Literature Review on Students' Epistemological Barriers in Mathematics Learning Reviewed from Conceptual Understanding

Nur Asiah¹, Suharti², Nursalam³, Nurul Khusnah⁴

^{1,2,3,4}Universitas Islam Negeri Alauddin Makassar

Email: suharti.harti@uin-alauddin.ac.id

ABSTRACT

Obstacle epistemological is one of the factor main obstacle quality understanding draft participant educate in learning mathematics. This obstacle arises when participant educate experience difficulty connect the meaning of a concept with procedures taught, so knowledge that is formed become shallow and difficult transferred to context new. Condition the often culminating in the emergence of misconception as well as obstacle in solution problem mathematics in a way flexible and logical. Based on condition this study aims to for study obstacle epistemological participant educate in learning mathematics reviewed from understanding concept, identify factor the cause, and review pattern findings study previously related issue. This research uses method literature review with analyzed 25 published articles between 2020 to 2025. Research results show that obstacle epistemologically very closely relation with weakness understanding draft participant educate, especially on material that requires ability high representational and relational like algebra, geometry, sequences and series, and inequality causal factors. These obstacles include too much learning focus on procedures, minimal use visualization, lack of activity reflection conceptual, as well as dense restrictive curriculum exploration draft in a way in-depth. This finding confirms importance implementation approach learning that emphasizes understanding concept, giving assessment formative in a way sustainable, as well as use of reflective strategies to minimize obstacle epistemological and improving quality understanding draft mathematics participant educate.

Keywords: *Barriers epistemological, understanding concept, learning mathematics, studies library.*

1) INTRODUCTION

In the era of globalization currently, quality source Power man become determinant main progress of a nation. Education plays a role as factor main in form quality individuals as well as own ability for complete in the middle an increasingly diverse society competitive (Adita & Napitupulu, 2023). In essence, education is a process for add knowledge and change attitude to more direction Good (Rahima & Ruli, 2025). Education becomes reject measure that differentiates generation previous generation now, and future generations come, is it show improvement or decline in matter quality (Afsari, Safitri, Harahap, & Munthe, 2021). On the other hand, the educational process need

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Faculty of Teacher Training and Education
Universitas Islam Negeri Alauddin Makassar
South Sulawesi-Indonesia

designed such appearance so that it can grow method reflective and conceptual thinking, not just procedural.

In context formal education, learning process is component main function for reach objective education. Learning is a process that aims for push participant educate to experience activity study (Maulana Akbar Sanjani, 2021). Learning can interpreted as an effort for grow motivation study participant educate to be able get results optimal learning (Harefa, 2023). Teachers need to designing in a way detailed objective learning that is intended achieved, the material to be delivered, the learning model that will be applied, as well as method evaluation that will be used (Yadrika, Roza, & Murni, 2022). With planning mature learning, teachers are expected capable create a meaningful learning process as well as relevant with need participant educate, this is very important especially in learning mathematics.

Mathematics is one of the eye lessons that have very important role in life everyday and is science that consists of on interrelated concepts related between one with others. Mathematics is base important in form method think critical participant educate For face various challenge in life and development knowledge (Nabila & Sari, 2023). Mathematics help somebody practice ability think logical and encouraging development various field knowledge other so that education mathematics own a very important role for every individual (Koly et al., 2023). Mathematics not only play a role in form method think critical participant educate for face various challenge life and development knowledge knowledge, but also aims to make them capable understand various concept, explain relatedness between concept, as well as apply draft or procedure in a way flexible, precise, efficient and accurate in finish problem mathematics (Meliani, Mulyani, & Muslim, 2024). In other words, to realize learning effective mathematics, participants educate need not only proficient counting, but also understanding meaning draft as well as can apply it in situation life daily.

In fact, learning mathematics still often faced with various problems, one of which is is occurrence obstacles to participants educate to concepts mathematics. Many participants capable students follow procedure for finish about, but not yet fully understand meaning or relatedness steps the in different contexts (Nasution, Mellawaty, & Surono, 2025). Obstacles epistemology often appear when participant educate not yet own understanding deep concept, so when faced with the problem or different contexts from the usual they learn, they experience difficulty For generalize and relate draft in a way flexible (Ruli, Juandi, Dahlan, & Maudy, 2025). Obstacles epistemology covers not only

difficulty in memorize procedures, but also in understand meaning concepts and relate them with steps-procedures, so that participant educate more superior in do operation compared to understand the “why” behind operation the (Khairunisa, Heryani, & Rustina, 2024). Conditions the show that obstacle epistemology own role important in influence level understanding draft participant educate to material mathematics.

Understanding draft is ability participant educate for control meaning from an idea or principle mathematics. Understanding draft mathematics covers ability participant educate for understand the meaning behind procedures, recognizing relatedness between concepts, and apply them in a way flexible in context different, isn't it? just do algorithm in a way mechanical (Hurrell, 2021). Research by Chirove & Ogbonnaya (2021) show that when instructions learning emphasize aspect conceptual besides procedural, ability participant educate in generalize and apply draft to situation new increase in a way significant (Chirove & Ogbonnaya, 2021). In addition, the learning designed with manipulative, visualization, and representation double proven strengthen understanding draft with help participant educate see structure and relations draft mathematics in a way more concrete (Bognar, Horvat, & Matić, 2025). In condition on the contrary, dominance learning procedural without support meaning conceptual often become source emergence misconceptions and difficulties in concept transfer to situation new (Hurrell, 2021). With thus, building understanding deep concept become runway important for overcome obstacle epistemological participant educate in learning mathematics and improve quality results Study in a way overall.

A number of study previously has study obstacle epistemological in learning mathematics and giving contribution important to improvement understanding draft participant educate. Research by Dewi, et al. (2021) find that participant educate often stuck in a procedure count without understand meaning draft exponent in a way intact. Research by Parawansa & Siswanto (2021) show that obstacle epistemological appear when participant educate memorize formula arithmetic social without understand its relevance with context real (Parawansa & Siswanto, 2021). Meanwhile, research by Koly et al. (2023) confirm that misconception beginning from experience study previously participate make things worse obstacle in understand draft mathematics in a way deep. From several study the show that obstacle epistemological appear because learning more emphasize procedure than understanding draft deep. In this regard, the study library about obstacle epistemological in learning mathematics reviewed from understanding draft become very important done, because study the allows researchers

for synthesize results study previously, found pattern, factor causes, and effective strategies for teaching more mathematics meaningful.

2) METHODS

This research uses approach studies literature that focuses on the collection and analysis of relevant written data with topic obstacle epistemological participant educate in learning mathematics, in particular reviewed from understanding concept. This research focuses on the utilization of existing ideas in journals, articles scientific, and sources trusted other as material analysis and interpretation. Initial steps this method begins with search relevant references and information with topic study. Furthermore, the author read in a way careful every source and do stage sorting with choose sentences, paragraphs, or related information direct with theme research. Then, the results reading noted, and the relevant parts given sign, good through ruler default, brackets, or another sign for make it easier identification stage next, the author analyze sentence or which information will be entered to in study literature with notice suitability flow and focus research. After that, the information that has been chosen arranged in paragraphs that are coherent and systematic in order to form channel coherent study. Author then formulate conclusion based on analysis literature that has been done. The final step, the author conduct a review with examine return overall study literature so that the results study easy read, understood, and provide comprehensive overview as well as systematic about topics studied (Rahayu, Rosyadi, Barlian, & Sauri, 2021). With Thus, this research is expected capable serve deep understanding about obstacle epistemology and understanding draft mathematics student based on sources trusted.

3) RESULTS AND DISCUSSION

Based on results search and selection literature in accordance the established criteria, 25 articles were obtained journal relevant national and international with topic obstacle epistemological participant educate in learning mathematics, especially those reviewed from understanding concept. Articles the covering study descriptive study qualitative, as well as study experimental that focuses on understanding draft mathematics participant educate, analyze obstacle epistemological, as well as factors that influence ability participant educate in finish problem mathematics. This study emphasizes that understanding draft is the core of obstacle epistemological, both in material algebra, geometry, statistics, and topics mathematics other.

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The following table presents relevant articles in study this literature.

Table 1: *Article*

No.	Article Title	Author & Year	Research result
1	<i>Epistemological Obstacles on The Quadratic Inequality</i>	(Tamba & Saragih, 2020)	IX th grade junior high school students experience difficulty in understand symbols and procedures in inequalities square, shows obstacle epistemological in draft base algebra.
2	<i>Analysis Epistemological Obstacle in Comparative Material 8th grade junior high school students</i>	(Rismayantini, Kadarisma, & Rohaeti, 2021)	Obstacle appears in understanding draft comparison, especially in apply draft in a way right on the mark.
3	<i>Epistemological Obstacle Student Based on SOLO Taxonomy on Geometric Sequences and Series Material</i>	(Khairunisa et al., 2024)	Participant educate own difficulty in understand and connect draft rows and series, with level understanding varies according to SOLO taxonomy.
4	<i>How Students' Obstacle in Solving Mathematical Tasks Deal with Linear Equation in One Variable</i>	(Wicaksono, Prabawanto, & Suryadi, 2024)	Obstacle seen in understanding procedures and concepts base linear equation one variables, including symbols and operations algebra.
5	<i>Analysis of Student Learning Obstacles in Exponential Materials: Exploratory Case Study</i>	(APS Dewi, Zaini, Rizal, & Safitri, 2023)	Participant educate experience obstacle ontogeny in the form of limitations readiness learning, obstacles epistemological in understand and apply draft exponential, as well as obstacle didactic consequence method inadequate teaching effective.
6	<i>Learning Obstacle of Students in Geometrical Sequence and Series</i>	(Magfiroh, Prabawanto, & Rosjanuardi, 2024)	Participant educate experience obstacle ontogeny Because not enough understand concept and confused differentiate formula arithmetic as well as geometry, resistance didactic consequence method too much teaching fast, and obstacles epistemological when face question with form that is not normal.
7	<i>From Arithmetic to Algebra: Students' Epistemological Obstacles</i>	(Ruli et al., 2025)	Participant educate experience difficulty understand inequalities, especially in symbolization and application draft.
8	<i>Analysis of Learning Obstacles for Junior High School Students in</i>	(Wantah & Prastyo, 2022)	Obstacle appears in understanding the concept of lines and angles, especially in

	Understanding the Concept of Lines and Angles		implementation theorems and constructions geometry.
9	<i>Learning Obstacles for Junior High School Students in Mathematics Material</i>	(Firda & Juandi, 2023)	Obstacle epistemological appear in various material junior high school mathematics, including algebra, geometry, and statistics.
10	<i>Investigation of Secondary Students' Epistemological Obstacles in the Inequality Concept</i>	(Siagian, Suryadi, Nurlaelah, & Prabawanto, 2022)	Participant educate experience difficulty understand inequalities, especially in symbolization and application draft.
11	<i>Lower Secondary Students Epistemological Obstacle in Solving Mathematical Literacy Task: Focus on Plane Geometry</i>	(Murni, Suryadi, & Prabawanto, 2025)	Obstacle appears in the understanding and application draft geometry fields, including error interpretation symbols and procedures.
12	Epistemological Barriers to Conceptual Understanding Based on Solo's Taxonomy in Students	(Atiqah, Sugiatno, & Romal, 2020)	Obstacle epistemological appears in understanding draft mathematics student class VIII, level understanding varies according to SOLO taxonomy.
13	<i>Analysis of Learning Obstacles in Fraction Material For Grade V Elementary School Students</i>	(Ratu, Hermansah, & Ayu, 2025)	Participant educate experience limitations readiness Study like weakness mastery draft prerequisites and mental unpreparedness in understand fractions. Participants educate only understand example familiar questions so that difficulty apply draft fractions in context different, including fractions varying mixes and operations. The barriers are also reinforced by the method too much teaching procedural, lack of concrete media, and presentation material that is not support understanding draft in a way deep.
14	Student Learning Obstacles in Enumeration Rules Material	(Santosa, Indrawati, & Bahri, 2024)	Obstacle appear from weakness mastery material prerequisites, including operation basic and low sense of trust self-participant educate in face question combinatorial. Participants educate difficulty differentiate draft permutations and combinations as well as no capable apply rule enumeration in more context complex. This difficulty is exacerbated by the method dominated learning lecture without support for visual media or varied learning strategies.

15	Analysis of Learning Obstacles to Arithmetic Operations of Dividing Whole Numbers in Grade III Elementary School Students	(Amalia, Apriani, & Lidinillah, 2025)	Participant educate Not yet capable understand connection between division and multiplication as well as show weakness in interpret visual representations such as bar and pie charts. In the context of question real, students-difficulty apply draft distribution in a way right. Lack of use of concrete media, tools props and approaches learning contextual participate strengthen obstacle concepts, procedures, and experienced representation student.
16	<i>Learning Obstacle</i> Analysis of Triangle Material for Grade VIII Students of the Christian Education Foundation (YPK) Pontianak Middle School	(Feniber & Saputro, 2024)	Participant educate experience limitations readiness cognitive in recognize types triangle and understanding draft wide and around. Knowledge student only limited to a few example certain so that experience difficulty when draft implemented in situation different. This obstacle is exacerbated by the presentation of insufficient material in accordance with method think students, as well as teaching materials that are not support understanding draft triangle in a way systematic.
17	<i>Epistemological</i> Analysis of Obstacles of Vocational High School Students on the Material of Composition Functions	(Indah & Kadarisma, 2023)	Participant educate experience obstacle epistemological Because not yet understand draft function composition in a way intact. Participants educate only capable finish routine matters but experience difficulty when question shaped story or context different. Limited knowledge cause inability apply concept in the situation new.
18	<i>Systematic Literature Review:</i> Obstacles to Student Learning in Statistics Material at Junior High School Level	(Saputri, Suryadi, & Nurjanah, 2024)	Participant educate experience obstacle ontogeny, epistemology, and didactics. Difficulties appears in the concept of median, quartile, average, reading diagrams, and use formula. Understanding draft Not yet intact so that participant educate No capable finish question when form and context changed.

19	Analysis of Learning Obstacles <i>for</i> Junior High School Students on the Material of Opportunities	(Maharani, Dasari, & Nurlaelah, 2022)	Participant educate experience misconception opportunity. Because limitations understand room sample, point samples, and comparisons opportunities. Many participants educate use intuition or belief personal, not analysis mathematical. Unpreparedness draft set make things worse obstacles that arise.
20	<i>Development of Teaching Materials Based on Two-Column Proof Strategy on Congruent Triangle Materials</i>	(Scristia, Meryansumayeka, Safitri, Araiku, & Aisyah, 2022)	Participant educate experience difficulty compile proof congruence triangle consequence weakness ability reasoning and mastery draft geometry. Many errors in connection logical inter-21statement. Two-column proof- based teaching materials help reduce obstacle the.
21	<i>Epistemological Obstacles in Learning Trigonometry</i>	(Maknun, Rosjanuardi, & Jupri, 2022)	Participant educate experience obstacle epistemological in understand trigonometry, especially the concept of radians, the value of π , representation graphs, as well as mark function trigonometry in all angle. Participants educate tend linking mark trigonometry with corners special that has been memorized, so that difficulty when context change. Obstacles the more looks when participant educate only follow procedures (eg. change degrees – radians) without understand origin formula. They are also wrong-interpret coordinate points on the graph trigonometry and looking at π in a No consistent.
22	Error Analysis in the Material on Sequences and Series Reviewed from the Ability to Understand Concepts by Providing Learning Video Material	(Wijayanto & Munandar, 2021)	Participant educate experience difficulty understand concept and determine formula line arithmetic and geometry, especially in interpret question story mathematics. This difficulty is caused by inadequate online learning. effective, less thorough, and facilities limited learning. As a result, participants educate often make error concepts and techniques that reduce results learning. The solution is implementation method learning effective such as learning videos and helpful teacher guidance repair understanding and accuracy participant educate.

23	Analysis of Students' Errors in Algebra Material Reviewed from the Ability to Understand Mathematical Concepts	(Putri & Roesdiana, 2023)	Participant educate difficulty understand draft algebra, including determine coefficients and variables as well as do operation algebra with right. The causal factors are lack of attention, motivation, understanding materials, as well as disorder in workmanship question. This error has an impact on low success Study algebra. The solution covering guidance more intensive, training more questions many, and implementation method fun and easy learning understood for increase understanding and skills participant educate.
24	Analysis of Learning Barriers to Fraction Material	(Ulfa, Jupri, & Turmudi, 2021)	Obstacle ontogenic: motivation low, less focus. Obstacles didactical: the teacher emphasizes procedure without meaning, students Confused procedure operation fractions. Obstacles epistemological: limitations understanding operation number round with fractions.
25	Students' Epistemological Obstacles in Solving Circle Problems Reviewed from the <i>Perspective of Self-Regulated Learning</i>	(Meliani et al., 2024)	Participant educate with high SRL: resistance generalization. Participants educate with moderate SRL: inhibition intuition fallacy, generalization, language natural. Participants educate with low SRL: resistance intuition fallacy, generalization, language natural more dominant.

Based on results study to gathering article national and international issues that discuss obstacle epistemological participant educate in various topic mathematics, obtained description general that participant educate still experience complex difficulties in the process of understanding draft mathematics. In overall, the obstacles that arise covering obstacle epistemological, obstacles ontogeny, as well as obstacle didactic. Most of the studies show that participant educate not yet capable connect concepts basic, especially on material that requires representation symbolic and abstract tall like inequalities, functions, algebra, sequences and series, exponentials, geometry, and statistics. This condition is visible from trend participant educate only memorize procedure without understand the meaning behind step settlement.

Obstacle epistemological looks dominant in understanding symbols, application concepts in different contexts, and the inability connect representation mathematics. Many participants educate only can finish routine matters, but experience difficulty when face question with form new, question story, or situations that require reasoning more-deep. This happens in various material like inequality squares, ratios, sequences and series geometry, linear equation one variables, up to trigonometry where participants educate looks fixated on the examples presented by the teacher. Difficulty symbolization, misconceptions, wrong generalizations, and interpretation graph that is not appropriate become reason main emergence obstacle epistemological.

In addition, the obstacles ontogeny is also a lot reported, especially related with readiness Study participant less than optimal education. Some studies find that participant educate not yet control draft prerequisites, less own trust self, and not capable differentiate formula or characteristic similar mathematics. Readiness low learning seen strong on material fractions, geometry, probability, and operations count, where participants educate difficulty linking material previously with draft new things that are learned. This unpreparedness makes participant educate easy do error procedural at a time strengthen obstacle epistemology that has been there is.

On the other hand, the obstacles didactic appear as consequence from inadequate learning strategies effective. Many articles take notes that teachers often emphasize procedure in a way fast without give understanding adequate conceptual framework. The lack of variation example, lack of use of visual media, approaches that do not contextual, as well as not enough optimal questioning process answer cause participant educate to get chance for build meaning mathematics in a way independent. In some cases, online learning, lack of facility learning, and teaching materials that are not in accordance characteristics cognitive participant education also makes it worse obstacles that occur.

In a way overall, results study show that obstacle epistemological participant educate very closely related with level understanding the concept that they have. When understanding draft Still shallow, participants educate tend depend on memorization procedure so that no capable finish question with changing context. Therefore, to minimize obstacle epistemological, various study emphasize importance participant-centered learning education, use of concrete and visual media, approach contextual, as well as giving chance for participant educate for reflect mistakes and thought processes

they. Approaches the believed capable strengthen understanding conceptual and reducing various form obstacles encountered in learning mathematics.

Discussion

In the era of learning modern mathematics, various study has highlight that obstacle participant educate no only nature technical or procedural, but also rooted in aspects understanding deep concept. One of the elements that appear strong is obstacle epistemological, namely difficulty participant educate in understand knowledge mathematics in a way conceptual and relate it with different representations. For example, the study latest show that participant educate experience difficulty for understand draft relations and functions when requested determine the domain, codomain, or presenting in representation different indications clear that mastery draft not yet adequate (Firda & Juandi, 2023). The same difficulties appears in the inequality square, where participants educate class IX no capable interpret symbols and steps settlement with correct (Tamba & Saragih, 2020). This condition confirms that learning no enough emphasize understanding deep, so that participant educate tend memorize step without understand structure mathematically.

a. Obstacles Epistemological in Understanding Mathematical Concepts

Obstacle epistemological in learning mathematics happen when student own difficulty in connect meaning draft with formal procedures taught by teachers in class (Hurrell, 2021). On the material comparison, participants educate known difficulty when apply draft to form different questions (Rismayantini et al., 2021). Obstacles similar found in the material rows and rows geometry, where participants educate no can linking the ideas of the sequence with series so that level understanding varies according to SOLO taxonomy (Khairunisa et al., 2024). In the material linear equation one variables, participants educate experience obstacle in connect symbol algebra with meaning numerically, so that happen error in operations and elections procedure (Wicaksono et al., 2024). In addition, the obstacles epistemology is also seen in the concept inequality, where participants educate fail understand symbolism and interpretation sign inequality, good in real numbers and context algebra (Siagian et al., 2022). More far, participants educate often not can connect draft fractions with operation number round, so that happen confusion in visual and symbolic representation (Ulfa et al., 2021). Participants educate only focus on procedures tend fail understand why step certain done so that appear misconception to basic ideas mathematics (APS Dewi et al., 2023). According to Chirove

& Ogbonnaya (2021), understanding conceptual allows student transfer ideas from one context to other contexts in particular flexible, which is not can done by participants educate with understanding procedural (Chirove & Ogbonnaya, 2021). When participants educate understand relation between symbols and meanings conceptually, they capable interpret repeat procedure become more knowledge deep and meaningful (Bognar et al., 2025). In contrast, participants educate with understanding weak will more often experience obstacle epistemological because no can connecting old ideas with new ideas in a way logical (Ruli et al., 2025). With thus, the obstacles epistemological become indicator direct from weakness ability conceptual student in internalize the meaning of a concept mathematics (Nasution et al., 2025).

In a way whole, entire findings the show that obstacle epistemological is the core of failure participant educate in understand structure knowledge mathematics as it should be they get up in a way gradually.

b. Causal Factors Obstacle Epistemological

Obstacle epistemological appear because learning often emphasize algorithm compared to meaning from steps the (Tamba & Saragih, 2020). Educator factors hold role big when the approach used not enough emphasize connection between draft (Siagian et al., 2022). Limitations visual representation causes participant misinterpreted graphs, diagrams, and form geometry, such as in division number count (Amalia et al., 2025). This is a limitation visualization and representation symbolic make participant educate difficulty understand abstract idea structure (Murni et al., 2025). In addition, the weakness readiness Study make participant educate easy to misunderstand procedure as in exponential, where the resistance ontogeny, epistemology, and didactics happen in a way simultaneously (APS Dewi et al., 2023). Lack reflection and activities metacognitive make things worse error think because learners not used to assess cognitive processes they alone (Rahima & Ruli, 2025). Error conceptual formation since beginning learning can also long lasting and inhibiting understanding continuation, obstacles epistemological is accumulation from factor pedagogical, psychological, and epistemological which are interconnected related (Koly et al., 2023). With thus, the obstacles epistemological in learning mathematics appear because learning more emphasize algorithm than meaning concept, accompanied by limitations visualization, lack of reflection, as well as weakness ability metacognitive, so that become results from combination factor pedagogical, psychological, and epistemological which are interconnected related.

A dense curriculum also strengthens emergence obstacle epistemological because time exploration draft become limited, educators more focus pursuing completion targets material than strengthen understanding deep participant educate (Maulana Akbar Sanjani, 2021). Lack of time for exploration and reflection cause misconception no completed and moved to topic next as well as participant education is also rare given chance discuss and clarify their ideas so that error understanding left alone attached (Wantah & Prastyo, 2022). Approach inquiry and constructivism recommended because allows participant educate build draft in a way independent through experience study active, factor curriculum, teachers, and experience fragmented learning contribute to low understanding draft mathematics (Magfiroh et al., 2024). Barriers epistemological in learning mathematics reinforced by a dense and limited curriculum time exploration concept, so that teachers are more focus on completion material than understanding deep students, meanwhile lack of reflection and discussion cause misconception keep going continues, making factor curriculum, teachers, and experience fragmented learning as reason low understanding draft mathematics.

c. Coping Strategies Obstacle Epistemological

Approach based understanding conceptual demands that teachers emphasize connection between concept, not just exercise mechanics and also problem-based learning models push participant educate explore reason errors and find return structure draft in a way reflective (Yadrika et al., 2022). Utilization of interactive media like articulate Storyline proven increase conceptual visual understanding participant educate through simulation-based technology and theory Piaget's constructivism explains that understanding formed through the process of assimilation and accommodation from experience new (Adita & Napitupulu, 2023). Learning meaningful emphasize participation active participant educate in build meaning so that obstacle epistemological can minimized (Bognar et al., 2025). So, obstacles epistemological can minimized through an approach that emphasizes understanding conceptual, where the teacher helps participant educate build connection between draft in a way reflective with support for problem-based learning models, interactive media, and learning meaning that encourages participation active in build meaning from experience study.

Evaluation diagnostic based SOLO taxonomy can help teachers identify level understanding participant educate from unistructural until extended abstract as well as analysis results this assessment

is used for determine intervention appropriate pedagogical need individual (Atiqah et al., 2020). Teachers can combine assessment formative and reflective self for strengthen awareness conceptual participant educate, approach metacognitive like self-explanation allows participant educate reveal the reason behind step settlement (Rahima & Ruli, 2025). Implementation of reflective and assessment strategies sustainable produce improvement significant in quality understanding draft mathematics. Efforts subtraction obstacle epistemological must nature systematic and data-based results evaluation conceptual participant educate (Hurrell, 2021). Evaluation diagnostic based SOLO taxonomy helps teachers recognize level understanding participant educate and design intervention appropriate pedagogical with need individual, while combination assessment formative, reflection self, and approach metacognitive like self-explanation strengthen awareness conceptual participant educate, so that application of reflective strategies and assessment sustainable in a way systematic can lower obstacle epistemological and improving quality understanding draft mathematics.

d. Implications Theoretical and Practical to Learning Mathematics

In a way theoretical, research about obstacle epistemological expand perspective that study mathematics no only just a process of remembering and applying algorithm, but also an effort build understanding deep conceptual through reflection to structure knowledge complex mathematics (Murni et al., 2025). This understanding is in line with paradigm constructivist who emphasizes that knowledge formed in a way active by individuals through the interaction process cognitive with environment learning and not accepted in a way passive from teachers (Hurrell, 2021). Integration between knowledge conceptual and procedural become an important pillar in learning mathematics because both of them each other complement, where understanding draft allows participant educate interpret procedure in a way meaningful and procedural help strengthen representation cognitive to draft (Bognar et al., 2025). This study also provides contribution significant to development theory mathematical literacy, namely ability individual for identify, understand, and use concepts mathematics in context life diverse and dynamic reality (Koly et al., 2023). With understand source emergence obstacle epistemologists, teachers and researchers can develop a more effective learning model reflective and contextual, where participants educate not only memorize formula but construct meaning and relationship inter-concept in a way logical (Adita & Napitupulu, 2023). Therefore, the contribution theoretical from this research is located on the expansion paradigm learning mathematics

going to a more approach meaningful, reflective, and meaning-oriented conceptual, not just skills mechanistic.

In a way practical, results This study provides guide real for teachers in designing learning mathematics that emphasizes understanding conceptual through interactive, reflective, and contextual approach, in accordance with need study participant educated in various level ability (Magfiroh et al., 2024). Teachers are advised for integrate activity learning that encourages participant educate explain return draft with language they yourself, because this strategy is proven strengthen understanding structural and reducing misconception to draft abstract mathematics (Chirove & Ogbonnaya, 2021). In addition, learning based discussion groups and bait come back formative can create environment study collaborative facilitating clarification of ideas, so that error conceptual can repaired through the process of argumentation and exploration together (APS Dewi et al., 2023). Teachers can too apply assessment formative-based reflection independent for push awareness metacognitive participant educate to be able assess and improve method think mathematical they Alone in a way systematic and sustainable (Nasution et al., 2025). With put understanding draft as focus main in the learning process, the teacher does not only increase results academic participant educate, but also build ability think critical, reflective, and creative which becomes competence 21st century. Implications This practice confirms that success learning modern mathematics should be measured based on depth understanding conceptual students, not only on ability they in answer question in a way procedural (Ruli et al., 2025). So, learning mathematics that emphasizes understanding conceptual through approach interactive, reflective, and contextual capable help participant educate build deeper meaning deep to the concepts studied, where the activities discussion, reflection independent, and assessment formative play a role important in strengthen awareness metacognitive, improving error conceptual, as well as develop ability think critical, reflective, and creative as base success learning modern mathematics.

In a way overall, obstacles epistemological in learning mathematics appear when participant educate difficulty linking meaning draft with different symbols, procedures, and representations, so that understanding that is formed become no intact. This obstacle is increasingly reinforced by the low readiness learning, weakness mastery draft prerequisites, as well as approach too much learning emphasize procedure without give room for exploration concepts and reflections. Limitations visualization, lack of chance discuss, and not existence involvement active participant education also

worsens error conceptual that has been there is. Therefore, it is necessary learning that focuses on understanding conceptual, activities reflective, use representation diverse, as well as assessment helpful diagnostics identify difficulty since early, so that participant educate can build greater understanding deep and reduce emergence obstacle in learn mathematics.

4) CONCLUSION

Obstacle epistemological in learning mathematics appear when participant educate experience difficulty linking meaning draft with procedures learned. This obstacle is exacerbated by more complex learning emphasize algorithm compared to meaning concept, limitations reflection, as well as dense curriculum. Other contributing factors is lack of time exploration concepts and methods inadequate teaching varied. Efforts to overcome obstacle epistemological can done through approach learning that emphasizes understanding conceptual, use of interactive media, problem-based learning strategies, assessment formative, as well as activity discussion and reflection independent. With thus, learning that is oriented towards meaning can reduce obstacle epistemological and improving ability think critical as well as understanding deep participant educate in mathematics.

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