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Students' degenerative thinking disposition on non-relational aspects in solving quadrilateral problems

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Abstract: The urgency of this research is to see the tendency for non-generative thinking in students to solve rectangular problems, which defined as a degenerative thinking disposition. A degenerative thinking disposition is a person's tendency to take action that ignores information excessively without considering analytical and genetic characteristics in generalizing a problem. The results of the preliminary study show that there are indications of non-generative thinking when students solve problems regarding the perimeter of a rectangle. Many students point out the incompleteness of the solution to the problem of the perimeter of a quadrilateral and tend to be hasty in assuming that the quadrilateral in question is a rectangle. This included in the symptoms that do not give rise to relational aspects. This type of research is qualitative with an exploratory, descriptive approach to three subjects. The data analysis technique uses thematic analysis steps. The results of the study show that students who experience degenerative thinking dispositions from non-relationship aspects ignore information excessively. Students with non-relationship aspects tend to experience excessive information neglect when relating information to definitions and analytical and genetic properties. Students overgeneralize the problem of rectangular properties without considering the existence of other esufficient elements. The concepts used in concluding problem solutions are based on still partial concepts. So the generalizations that are used as the basis for solving other problems end up being wrong.

Keywords: Degenerative, Quadrilateral, Non-relationship thinking disposition

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INTRODUCTION

Generative thinking emphasizes the active integration of knowledge that previous students already have with new knowledge that is being studied or recently acquired (Osborne & Wittrock, 1985). Generative thinking indicates that the brain is used to actively construct an interpretation of the information obtained and then make conclusions (Grabowski, 2004; Osborne & Wittrock, 1985; Wittrock, 1992). Students who think generatively can understand problems from various perspectives of solving strategies, understand the depth of the problem, and can represent it (Cai & Hwang, 2002; Low & Hollis, 2003; Mushoriwa et al., 2010). Generative thinking is concerned with explaining the existence of a taxonomy of generalizations of a person (A. Ellis et al., 2017; A. B. Ellis, 2007b, 2007a). Ellis et al. (2017) and A. B. Ellis (2007) explain that One aspect of the taxonomy of generative thinking is the relational aspect. The relationship aspect occurs when a student makes a connection between two or more situations, problems, ideas, or objects. A student may look at a situation and connect it with a previous situation, or they may look at a situation and then produce another situation that he views as similar to the first. Indicators of generative thinking aspects of relations can be seen in Table 1.

TABLE 1. *Generative thinking indicators of relation aspects*

Aspects	Indicators
Relationship	Can relate knowledge that is already owned with information that exists in a particular event or case
	Can show an analytical definition of one or more objects based on information present in a particular event or case
	Can show the genetic definition of one or more objects based on information present in a particular event or case
	Can show similarities or differences of two or more objects based on their analytical properties
	Can show similarities or differences of two or more objects based on their genetic traits

Source: Ellis (2007a); Ellis et al (2017) and has been modified by researchers

Observations made on students regarding solving mathematical problems about quadrangles, found indications of answer tendencies that showed non-generative thinking. The following are questions asked to students. It is known that the quadrangle has a circumference of 20 cm and the length of one side is 4 cm. Determine the number of possible lengths of the other three sides! The results of one of the students' answers can be seen in Figure 1.

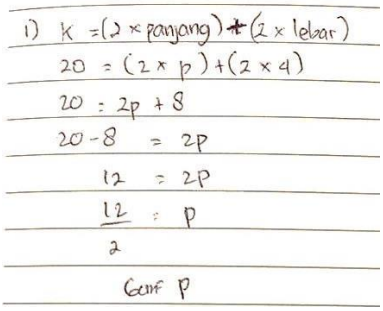


FIGURE 1. *Student answers*

Students are indicated to show correct solutions but still need to be completed in showing other suitable solutions. Inaccuracy usually occurs in applying a principle from one situation to another. Students overdo it by applying specific rules or principles to situations that should be avoided. In addition, students are accustomed to solving problems based on routine procedures. Students need to be used to solving math problems using definitions analytically or genetically.

Based on the results of observations made, students are indicated to be excessive in assuming that the rectangle must be rectangular. This suggests that students are excessively drawing conclusions and must be made aware of another element required to build a flat called a quadrangle. Students over-conclude something and assume that a quadrangle must be a rectangle. Suppose students are accustomed to using analytical or genetic definitions. In that

case, students can easily conclude that quadrangles are not just rectangles, depending on seeing from the closest family with the distinguishing elements (analytics) or from the formation process (genetics). Analytical and genetic definitions cannot be separated from the quadrangle because naming a quadrilateral depends on these definitions (Axworthy, 2021). This is contrary to the generative indicators of relation aspects in Table 1. Students experience a tendency to think non-generatively, especially in non-relational aspects.

The student replied that the rectangle in question was a rectangle, so it was found that the length of the other three sides was 6 cm, 4 cm, and 6 cm long. Students are exaggerated in assuming that a rectangle is a rectangle. In addition, the answer of one of the students also showed an indication of neglect in thinking, which was marked by the emergence of the rectangular circumference formula, even though the question in question was about quadrangles. The rectangle referred to in the problem the researcher gave is not just a rectangle but many possible rectangular flat shapes.

The case in students showed that students were trapped in sentences on questions containing the word "length of one side." The appearance of the word "length" in the question resulted in students immediately concluding that this question is about rectangles, where students are accustomed to the concept of rectangles that have length and width. So, at the end of the answer, the student found a solution that was still not right. In this case, students have been unable to apply the rules or knowledge they have in new situations (Brown et al., 2016; Esteley et al., 2010).

The tendency of students to think in solving a mathematical problem is significant because it can find out the type and location of student errors (Tong & Loc, 2017). In addition, according to Felder & Brent (2005), lecturers can understand the location and type of student difficulties by knowing the tendency of student thinking. So that lecturers can take action to determine the right strategy in the learning process. The habit or tendency to do something is also called disposition (Ennis, 1996). Disposition is also a cognitive style or habitual tendency to think that involves cognitive activity in solving problems (Tarchi & Villalón, 2021). Meanwhile, the disposition of thinking is students' desire, awareness, tendency, and intense dedication to thinking and acting in solving mathematical problems (Katz, 1993; Kilpatrick et al., 2001).

The intended disposition in this study is the tendency of someone who is hasty and excessive but does not consider the presence of other elements as sufficient conditions in concluding a mathematical problem. The tendency to think in each person may vary, depending on how he thinks in solving problems. The need for more accuracy in answering problems is very diverse, so their thinking tendencies will also vary(Moore et al., 2012). Based on this description, this study focuses on students' excessive thinking in solving quadrangular problems that do not consider other elements as sufficient conditions. Researchers define the tendency to overthink in generalizing a problem as a degenerative thinking disposition. The disposition of degenerative thinking is a person's tendency to overgeneralize a problem so that the solution obtained is not by the problem he faces.

Degenerative thinking is the thinking of someone who is not generative. Degenerative thinking can be defined as excessive thinking in generalizing a problem without considering other elements that are required sufficiently. Therefore, the solution obtained becomes less appropriate and inappropriate from the context of the discussed problem. This overgeneralization can appear because the person only uses the information he has in mind (Esteley et al., 2010). Overgeneralization can occur because only some samples are used in generalizing, but the sample needs to be representative. This research will explore more deeply related to students' degenerative thinking tendencies in solving quadrilateral problems.

METHODS

Research Design

This type of research is qualitative research with an exploratory, descriptive approach to the disposition of degenerative thinking of students in solving quadrangular problems (Creswell, 2012). The research uses qualitative with an exploratory, descriptive approach to the

disposition of students' degenerative thinking in solving quadrangular problems (Creswell, 2012; Haryoko et al., 2020). Based on initial observations, researchers found symptoms of degenerative thinking tendencies/dispositions in students when solving rectangular problems. Students ignore redundant information that does not consider the analytical and genetic traits elements of the quadrilateral. Students experience a narrowing of thinking where the student finds everyday events to be special events, for example, in the case of a quadrilateral, which is only considered a rectangle. Therefore, this research justifies the need for a more in-depth exploration of how students' degenerative thinking dispositions play out in solving rectangular problems.

Participant

Three students were selected as subjects in this study. The process of selecting subjects in this research was carried out in several stages, namely: (1) The researcher gave questions related to quadrangles to prospective subjects, (2) Assigned prospective subjects to say loudly what things they thought about when working on the questions (think aloud), (3) Prospective subjects who tend to think degeneratively are designated as the main prospective subjects in this research, (4) It clarifies things that need to be visible to prospective subjects when working on questions aloud (think aloud) through an initial interview, (5) Separating prospective subjects who have wrong answers, do not think aloud, and need better communication skills at the time of the initial interview are not included as research subjects.

TABLE 2. Coding Terms, Components and Indicators of Degenerative Thinking Tendencies

Term	Coding
Non Relation (at least only show one of the indicators based on the answer)	NR
There is excessive neglect of information in associating the knowledge that is already owned with information that exists in a particular event or case (*Non-Information Relations*)	NRI
There is excessive neglect of information that does not consider the analytical definition of an object or more based on information that exists in a particular event or case (*Non Relation Analytical Definition*)	NRDA
There is excessive neglect of information that does not consider the genetic definition of an object or more based on information that exists in a particular event or case (*Non Relation Genetic Definition*)	NRDG
There is excessive neglect of information that does not consider the similarity or difference of two or more objects based on their analytical properties (*Non Relation Analytical Properties*)	NRSA
There is excessive neglect of information that does not consider the similarity or difference of two or more objects based on their genetic traits (Non-Relation of *Genetic Traits*)	NRSG

Instruments and indicators

As a critical instrument, researchers directly observe and collect data from various sources, including based on interview transcripts, field notes, documentation, and audio and video recordings, then review the data obtained and provide meaning. The primary and research support instruments consist of test questions and in-depth interviews with research subjects. Ashlock's research instrument item was modified for the test question instrument (Ashlock, 2006). The instrument from Ashlock (2006) was modified and used to detect and select flat shapes, which are parallelograms.

Procedure and Data Analysis

Data collection in this research was carried out by giving students non-routine problems about quadrilaterals to work on. When working on test questions, students are asked to say aloud whatever they were thinking when solving the question (think aloud) and then write the explanation they gave on their answer sheet. Research also uses thematic analysis in data

preparation and organization for analysis, representation of findings in narrative and visual, interpretation of findings, and validation of the accuracy of findings (Clarke & Braun, 2013). This study will compile codes based on aspects of revealing degenerative thinking tendencies, as in Table 2.

RESULTS

This study qualitatively describes students' degenerative thinking tendencies in solving quadrangular problems. A quadrilateral is a polygon with four sides (Alexander & Koeberlein, 2020). A quadrilateral is a closed flat figure with four sides and four vertices, whose line segments only intersect at the endpoints (Boyd et al., 2008). Selected subjects were given test questions related to quadrilaterals, namely 'which of the following flat shapes is a parallelogram? give your reasons!', as in Figure 2.

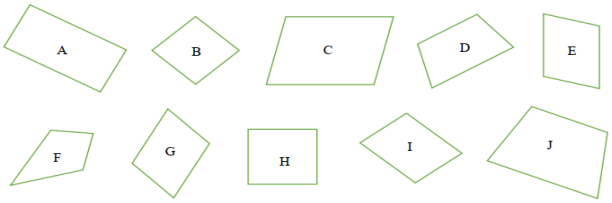


FIGURE 2. *Test questions about quadrangles.*

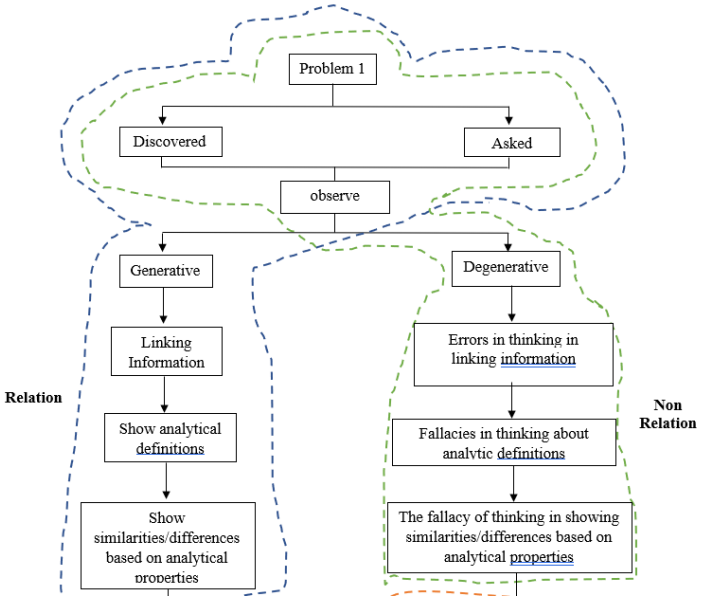


FIGURE 3. *First problem structure*

The degenerative thinking tendencies of subject one begin with a mental activity that associates the concept with the problem. Subject one shows the indications present on the indicator Non Relation. Subject one observed the flat-shape problem provided in the first problem and began to determine which parallelogram belonged by mentioning the characteristics of the parallelogram. Subject one said that parallelograms have the property of having two pairs of sides facing the same length and parallel, and the opposite angles are the same.

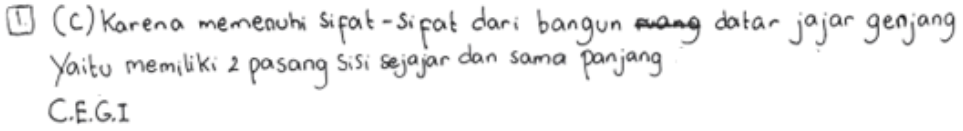
Subject one mentions the properties of the group whose shapes belong to parallelograms. However, subject one was too hasty in deducing if the wake was included in the parallelogram, thus ignoring other wakes with properties present in the parallelogram and stating that the parallelogram did not have a right angle. Subject one must be more accurate in concluding that parallelograms do not have right angles. So, summing up squares and rectangles does not include parallelograms. The following presents structuring the problem by subject one.

Processes of degenerative thinking tendencies in subject two are almost the same as in subject one. Problem-solving begins with mental activity by associating the concept with the problem. Subject two began to determine which parallelogram belonged by mentioning the features of the parallelogram. Subject two said that parallelograms have the property of having two pairs of sides facing each other of equal length and parallel and are oblique. Here are the results of think-aloud with subject two.

Think aloud

First, which of the flats built below is a parallelogram? Give your reasons!
A is not a parallelogram because A is a rectangle where all corners are right angles, which B is not because the angle is a right angle, the C is a parallelogram because it has two pairs of sides that are parallel and of equal length, and the shape is oblique. the D is not a parallelogram because there are sides that are not equal in length. the E is a parallelogram because it has two pairs of sides that are parallel and of equal length, and the shape is oblique. which F is not because F is a kite wake. the G is a parallelogram because it has two pairs of sides that are parallel and of equal length and are obliquely shaped. the H is not a parallelogram because the H is a square shape with all sides of equal length. the I is a parallelogram because it has two pairs of sides that are parallel and of equal length and are obliquely shaped. the J is not a parallelogram because the J is a trapezoidal.

Subject two ignored another wake that also had properties present in the parallelogram. Subject two assumed that parallelograms were based on commonly seen shapes, i.e., the parallelogram was identical to the oblique shape. Subject two hastened to conclude that the parallelogram was slanted, making it less appropriate to classify the flat structures based on their properties. Subject two grouped C, E, G, and I shapes into parallelogram groups. However, because of the rush, subject two concluded that the parallelogram was oblique and needed an angle; other builds with parallelogram properties were ignored. The answer to subject two can be seen in Figure 4.

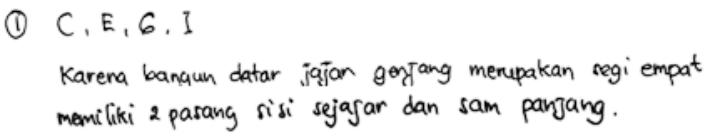


***Translate**: Because it fulfills the properties of a parallelogram, namely having two pairs of parallel sides and the same length. The shape that includes a parallelogram is C, E, G, I*

FIGURE 4. *Problem answer subject two*

Based on Figure 4, subject two was very hasty in concluding if another wake with parallelogram properties was not a parallelogram because its shape was not tilted.

The problem-solving of subject three also begins with mental activity, which is associating the concept with the problem presented. Subject three explained that the parallelogram is oblique like a typical parallelogram. Subject three began associating the idea with the situation in the issue, namely that the parallelogram does not have a right angle. Subject three hastily concluded that the parallelogram was oblique and had no right angle. This results in inaccurate grouping in other flat shapes that have parallelogram properties but are not shaped like parallelograms in general. Subject three looked at the provided flat shape based on its shape, so it was hasty to conclude that the parallelogram was, in his opinion, an oblique rectangle. This results in other buildings that have properties in parallelograms, such as squares, rectangles, and rhombuses, being neglected. This is also because subject three focused only on the general shape of the parallelogram. The following is the answer to the first problem of subject three in Figure 5.



***Translate**: Because a parallelogram is a quadrilateral that has two pairs of parallel sides and the same length*

FIGURE 5. *Problem answer subject three*

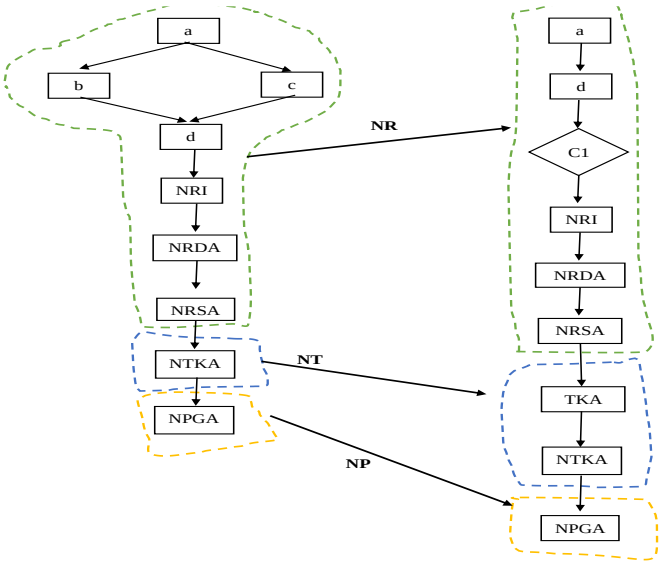


FIGURE 6. *Comparison of first problem structure and subject problem solving structure*

TABLE 3. *Summary of research subject data exposure (non relation)*

Subject 1	Subject 2	Subject 3
Finding initial ideas by mentioning the definition of parallelogram analytically Shows excessive neglect of information in determining parallelograms based on analytic definitions Shows excessive neglect of information in determining similarities or differences in flat images based on parallelogram analytical properties	Use facing sides and angles, as well as shapes or visual displays to determine parallelograms Shows excessive neglect of information in determining parallelograms based on facing sides and angles, as well as shape or visual appearance	Use facing sides and angles, as well as shapes or visual displays to determine parallelograms Shows excessive neglect of information in determining parallelograms based on facing sides and angles, as well as shape or visual appearance

Subject Three's answer to the problem-focused only on the general shape he usually encountered, so a generalization emerged from Subject Three that the parallelogram was oblique. The following is presented, and Figure 6 compares the structure of the problem with the thinking structure of subject three in solving the problem. Subjects with a tendency to think degeneratively non-related aspects can be seen based on data exposure and analysis in Table 3.

DISCUSSION

The tendency of degenerative thinking of students on aspects Non Relation (NR) shows almost the same characteristics. The three students who were the subjects experienced a mistake in thinking in relating the concepts they had to the problems faced. Students with degenerative tendencies in this study have a belief that the perspective is focused only on the shape of a flat building. It can be said that the student experienced NRI and NRSA. The perspective of students who experience tendencies NR affect students' analogy ability in solving a problem(A. Ellis et al., 2017). Students with a tendency to think degeneratively in aspects Non Relation (NR) shows almost the same characteristics. The three students who were the subjects experienced excessive ignorance of information in associating the concepts they had with the problems at hand. Students with degenerative tendencies in this study have a belief that the perspective is

focused only on the shape of a flat building. It can be said that the student experienced Non Relation Information (NRI) and Non Relation Analytical Properties (NRSA). The perspective of students who experience tendencies Non Relation affect students' analogy ability in solving a problem (A. B. Ellis, 2007b, 2007a, 2011). Students who experience Non Relation Information (NRI) neglect information excessively in associating the knowledge possessed with the information in the given problem. The student is excessive in associating the concept of parallelogram with other shapes that are different in shape from the general shape that appears. Students only look at a problem visually without considering other aspects (Dreyfus, 2002). Research results Lannin et al., (2006) states that visual images can influence the selection and use of student strategies in generalizing. Students also experience Non Relation Analytical Properties (NRSA), that is, the student experiences excessive neglect of information in showing the similarity of the parallelogram with other structures that have the properties of the parallelogram. The student ignores other wakes that have the properties of a parallelogram and because the shape is not similar to a parallelogram, it is said not to be a parallelogram. Students with a tendency to think degeneratively in aspects Non Relation excessive and hasty in concluding a problem so that it experiences excessive neglect of information in relating knowledge already possessed with existing information. Even though this information can construct the mindset of students so that it becomes a reference to draw a conclusion (Osborne & Wittrock, 1985). This is influential with the conclusions obtained when producing generalizations of a problem. Students with aspects Non Relation It tends to experience Excessive neglect of information in associating knowledge that is already possessed with information that exists in a particular event or case when associating information with its analytical and genetic definition and properties. This is in line with the finding that learners and students tend to rush when solving problems related to Geometry (Esteley et al., 2010).

CONCLUSION

Students with degenerative thinking tendencies tend to rush to conclusions and overestimate certain phenomena or events. Students with degenerative dispositions have unique characteristics. The characteristics of students' degenerative thinking disposition in Non-Relation aspects show (1) excessive neglect of information relating the concepts they have to the problem. Students with degenerative tendencies in this study believe in a perspective that focuses only on the shape of a flat shape; (2) excessive neglect of information in associating the concept of a parallelogram with other shapes differing from the general form that appears. The student needs to pay more attention to details in showing the similarity of the parallelogram with other structures that have the properties of the parallelogram. The student ignores other buildings that have the properties of a parallelogram, and because the shape is not similar to a parallelogram, it is said not to be a parallelogram. (3) Students with this Non-relational aspect tend to experience excessive neglect of information when associating information with its analytical and genetic definitions and properties.

REFERENCES

1. Alexander, D. C., & Koeberlein, G. M. (2020). Elementary Geometry for College Students. In *Cengage Learning, Inc. Unless*.
2. Ashlock, R. B. (2006). *Error patterns in computation : using error patterns to improve instruction* (9th ed.). Pearson Education.
3. Axworthy, A. (2021). *Motion and Genetic Definitions in the Sixteenth-Century Euclidean Tradition*. Max Planck Institute for the History of Science.
4. Boyd, Cummins, Malloy, Carter, & Flores. (2008). *California geometry: Concept, skills, and problem solving*. http://www.ias.ac.in/currsci/may252004/1355.pdf
5. Brown, J., Skow, K., & Center, T. I. (2016). Mathematics : Identifying and Addressing Student Errors. In *Vandaerbilt Peabody College*. https://iris.peabody.vanderbilt.edu/wp-content/uploads/pdf_case_ studies/ics_matherr.pdf
6. Cai, J., & Hwang, S. (2002). Generalized and generative thinking in US and Chinese students ' mathematical problem solving and problem posing. *Journal of Mathematical Behavior*, *21*, 401–421.

https://doi.org/10.1016/S0732-3123(02)00142-6
7. Clarke, V. ., & Braun, V. (2013). Successful qualitative research a practical guide for beginners (Braun, VirginiaClarke, Victoria) (z-lib.org). In *Successful qualitative research*.
8. Creswell, J. W. (2012). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. In *Educational Research* (Vol. 4). https://doi.org/10.1017/CBO9781107415324.004
9. Dreyfus, T. (2002). Advanced Mathematical Thinking Processes. *Advanced Mathematical Thinking*, 25–41. https://doi.org/10.1007/0-306-47203-1_2
10. Ellis, A. B. (2007a). A taxonomy for categorizing generalizations: Generalizing actions and reflection generalizations. In *The Journal of the Learning Sciences* (Vol. 16, Issue 2). https://doi.org/10.1080/10508400701193705
11. Ellis, A. B. (2007b). The Influence of Reasoning with Emergent Quantities on Students' Generalizations. *Cognition and Intruction*, *25*(4), 439–478.
12. Ellis, A. B. (2011). Generalizing-promoting actions: How classroom collaborations can support students' mathematical generalizations. *Journal for Research in Mathematics Education*, *42*(4), 308–345. https://doi.org/10.5951/jresematheduc.42.4.0308
13. Ellis, A., Tillema, E., Lockwood, E., & Moore, K. (2017). Generalization across Domains The Relating-Forming-Extending Generalization Framework. *Proceedings of the 39th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education.*, 677–684.
14. Ennis, R. H. (1996). Critical Thinking Dispositions: Their Nature and Assessability. *Informal Logic*, *18*(2), 165–182. https://doi.org/10.22329/il.v18i2.2378
15. Esteley, C. B., Villarreal, M. E., & Alagia, H. R. (2010). The Overgeneralization of Linear Models among University Students' Mathematical Productions: A Long-Term Study. *Mathematical Thinking and Learning*, *12*(1), 86–108. https://doi.org/10.1080/10986060903465988
16. Felder, R. M., & Brent, R. (2005). Understanding Student Differences. *Journal of Engineering Education*, *94 (1)*(January), 57–72. https://doi.org/10.4135/9781506342733.n2
17. Grabowski, B. L. (2004). Generative learning contributions to the design of instruction and learning. *Handbook of Research on Educational Communications and Technology*, *December*, 719–743.
18. Haryoko, S., Bahartiar, & Arwadi, F. (2020). *Analisis Data Penelitian Kualitatif (Konsep,Teknik, & Prosedur Analisis)*. Badan Penerbit Universitas Negeri Makassar.
19. Katz, L. G. (1993). Dispositions as Dispositions as Educational Goals . ERIC Digest . *ERIC Clearinghouse on Elementary and Early Childhood Education*, 1–5.
20. Kilpatrick, J., Swafford, J., & Bradford, F. (2001). *Adding It Up: Helping Children Learn Mathematics*. DC: National Academy Press. ftp://129.132.148.131/EMIS/journals/ZDM/zdm026r1.pdf
21. Lannin, J. K., Barker, D. D., & Townsend, B. E. (2006). Algebraic generalisation strategies: Factors influencing student strategy selection. *Mathematics Education Research Journal*, *18*(3), 3–28. https://doi.org/10.1007/BF03217440
22. Low, J., & Hollis, S. (2003). The eyes have it: Development of children's generative thinking. *International Journal of Behavioral Development*, *27*(2), 97–108. https://doi.org/10.1080/0165025024400047
23. Moore, K. D., &, & Hansen, J. (2012). Effective Strategies for Teaching in K-8 Classrooms. Chapter 2 Teaching Diverse Students. In *SAGE Publications (CA)*. https://doi.org/10.1207/s15327892mcp0202_6
24. Mushoriwa, T. D., Sibanda, J., & Nkambule, H. Z. (2010). Testing Generative Thinking among Swazi Children. *EDUCARE: International Journal for Educational Studies, Testing*, *2*(2), 197–210. https://doi.org/10.4314/njgc.v14i1.47641
25. Osborne, R., & Wittrock, M. (1985). The generative learning model and its implications for science education. In *Studies in Science Education* (Vol. 12, Issue 1).
26. Tarchi, C., & Villalón, R. (2021). The influence of thinking dispositions on integration and recall of multiple texts. *British Journal of Educational Psychology*, *91*(4), 1498–1516. https://doi.org/10.1111/bjep.12432
27. Tong, D. H., & Loc, N. P. (2017). Students' errors in solving mathematical word problems and their ability in identifying errors in wrong solutions. *European Journal of Education Studies*, *3*(6), 226–241. https://doi.org/10.5281/zenodo.581482
28. Wittrock, M. C. (1992). Generative learning process of the brain. *Educational Psychologist*, *27*(4), 531–541.