The Process of Assimilation-Accommodation in Solving the Problems of Proportion

Junarti Junarti*, Ari Indriani, Istiqomah Istiqomah

IKIP PGRI Bojonegoro, Indonesia
*Corresponding Author: junarti@ikippgribojonegoro.ac.id

Abstract. The purpose of this study was to describe the assimilation-accommodation process on a proportion topic. The descriptive qualitative approach was utilized to elucidate the assimilation-accommodation process. Data collection was accomplished using assessments administered to 13 students online and 7 students offline. The participants were chosen from a pool of twenty students based on their classification of procedural predictions of mathematical connection indicators. Six research subjects were selected from seven students who satisfied the expected indications of assimilation, accommodation, and assimilation-accommodation, with each category two students having the identical work. Additionally, data are gathered through tests and interviews that have been triangulated for source and method validity. The findings indicated the first two subjects demonstrate the assimilation process through the phases of proportion concept knowledge taught in primary school. This is shown by how the problem is solved, which begins with formulating the symbolic form proportion formula in variables. In proportion, the following two subjects demonstrate the accommodation process by converting their knowledge into different types of formula produced by assimilation groups, which is in the form of numbers. This is shown by how the problem is solved by immediately writing the answer into the proportion form without using another variable symbol. Meanwhile, the accommodation-assimilation process indicate a proclivity for modifying prior information by dividing proportion formula into different solution procedures from the assimilation and accommodation groups, i.e., in mixed form (some symbols and some numbers). The findings of this study indicate that the assimilation-accommodation process can aid in the acceleration of problem solutions in new materials.

Key words: assimilation process; accommodation process; assimilation-accommodation process.

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INTRODUCTION

Solving math problems requires students to go through the stages of problem-solving associated with mathematical procedures by utilizing their skill of the cognitive process. This is consistent with the aim of mathematics learning, which is to develop mastery of mathematics in the form of mathematical process abilities such as problem-solving, reasoning, communication, and mathematical connections (Rossydha, 2017).

Problem-solving is critical in mathematics because it allows students to acquire experience applying the information and abilities to new circumstances (Lahinda & Jailani, 2015). Each problem-solving situation necessitates certain procedures or techniques for resolving the issue. At each stage, the required problem of thinking processes that occur when incoming information is processed against the scheme (cognitive structure) that exists in the human brain is solved (Kurniawan et al, 2017). New experiences or knowledge will be processed via adaptation through the assimilation or accommodation processes (Kurniawan et al, 2017).

Assimilation and accommodation are two processes that students must go through when learning mathematics. Aside from that, it is also vital to be human while addressing difficulties in real life **(**Ningrum et al, 2019)**,** such as when handling problems involving proportion materials presented as story problems.

Connecting knowledge to real-world situations using mathematical concepts is an active process in mathematics. In this situation, the active process is the one that students use to solve problems (Suominen, 2015). Problem-solving occurs when students resolve a problem that develops, and the students engage in an active process (Rutherford, 2011). Several mathematical concepts, methods, or facts are comprehended during the problem-solving procedures if coupled with an existing network with a stronger or more connected network. In the student's mind, ideas, methods, or facts undergo assimilation and accommodation to determine the steps/procedures used to solve mathematical problems.

Additionally, the cognitive process in the human brain will result in the selection of relevant memories based on their experience and knowledge. New experiences or knowledge will be processed through an assimilation or accommodation process (Kurniawan et al, 2017).

Assimilation is a cognitive process that

happens when a person incorporates new perceptions or experiences into their mental model (Jalan et al, 2016: p.1495). According to Piaget, assimilation is when new objects, circumstances, and events are included in the preceding system (Piaget in **Dorko, 2019:** p. 6). The novel objects encountered in the proportion material obtained in junior high school grade VII might be based on students' daily life experiences or past educational experiences. Students will skip this assimilation phase if the initial process resolves the problem.

The assimilation process that occurs during the active process of mathematical connections is analogous to the proper relationship between two mathematical concepts A and B (Businskas, 2008), and the relationship between mathematical entities and other mathematical entities (Singletary, 2012). When conducting associations between components, there is a process of recalling prior information used to continue each problem-solving operation. This is referred to as the assimilation process.

During the problem-solving phase, students go through procedural assimilation, which includes a time of consideration on which steps to take. As Kosasih et al. described (Kosasih et al., 2018), the thinking process begins when external stimuli create an imbalance or mismatch between the previous experience (schematic) and the current experience. When this imbalance occurs, an imbalance between assimilation and accommodation occurs. Additionally, Kosasih et al. (2018) claimed that the scheme would evolve due to the adjustment or adaptation of previous experiences to new experiences.

Accommodation involves incorporating new information by creating a new scheme that matches the new design and modifying an old scheme to meet the new design (Kurniawan et al., 2017). The cognitive process that happens during the association of components in the problem-solving method has been altered in the new design in a new scheme based on newly acquired information. Rutherford (2011) defines cognitive assimilation as the expansion of a construct for the sake of the internal system's appropriateness, whereas cognitive accommodation is the modification of a construct for the new external/environmental system's compatibility. Thus, when an assimilation-accommodation process happens, the thinking process modifies the relationship between old and new information by developing a new scheme for problem-solving.

Previous studies have been conducted on a similar topic. Kurniawan et al. (2017) discuss the Polya steps-based thinking method used by grade VII junior high school students while solving math problems. The findings indicate that students with a high level of emotional intelligence are more adept at assimilation. According to Jalan et al.(2016), the assimilation framework enables highly competent students to solve issues, whereas the accommodation framework enables students with the moderate capacity to comprehend problems, prepare for problem solutions, and carry out problem-solving. Although the notion of permutations hampers its capacity during the rechecking phase of problem-solving, the accommodation thinking process can comprehend a problem, plan problem solving, and apply problem-solving to low-categorized students. According to Jalan et al. (2016), high-categorized students are more likely to use their assimilation framework when addressing the combination problem.

According to Yogi's research (2018), in the stages of problem-solving on Polya problems, assimilation can be completed until the stage understands and implements the solution plan. In contrast, the process of re-examination can be completed less perfectly. The process of assimilation and accommodations can be completed at the stage of planning a solution. Dorgo (2019) asserts that combining assimilation and accommodation can be utilized to construct frameworks for generalization. While Sopamena et al. (2018) also use Piaget's idea that the process or way of organizing and responding to diverse experiences is referred to as a scheme.

According to some of the research studies mentioned above, the assimilation process is more commonly employed when past knowledge may be applied to tackle the difficulties that are faced. Having prior knowledge becomes a valuable asset in the problem-solving process since it facilitates the critical thinking required. Specifically, this study aims to clearly understand the process of assimilation-accommodation in procedural problem solving on proportion material.

METHODS

The qualitative descriptive research design was employed in this study. In this section, all information gathered from the projected assimilation-accommodation process is presented in detail based on the results of the tests and the interview findings. Following this description,

the results are utilized to answer questions about the accommodation-assimilation process in relation to problem-solving, which is evaluated in accordance with the phases of the problem-solving procedure.

The data for this study were collected from seventh-grade junior high school students in Bojonegoro who completed an initial online and offline test on basic algebra with proportion material in consisting of up to twenty individuals. According to the exam, seven students worked offline and thirteen students worked online and submitted their work in the form of photographs. Additionally, this study analyzes the test results using procedural connection prediction indicators. Then, these findings are utilized to guide the selection of research subjects.

The following is a summary of students' works results that have been classified according to predictions of procedural mathematical connections. Three predictions of procedural mathematical connection indicators are met if the students: (1) can carry out the process of understanding the problem from the given problem, namely by writing down what is known and asked, (2) can identify what is known based on the mileage knowledge possessed, allowing for unit conversion, kilometers into meters, as well as the quantity of gasoline and mileage used in the proportion formula, (3) can express the settlement structure in the form of a direct proportion or inverse proportion as shown in Table 1 below.

Table 1. Summary of subject categorization based on predictions of mathematical connections procedurally

Items	Subject Distribution	
	Meet Predictions	Does not Meet Predictions
1	S-1, S-2, S-4, S-5, S-6, S-8, S-9, S-17, S-19, S-20	S-3, S-7, S-10, S-11, S-12, S-13, S-14S-15, S-16, S-18
2	S-1, S-2, S-4, S-6, S-7, S-8, S-11, S-12, S-16, S-19, S-	S-3, S-5, S-9, S-10, S-13, S-14, S-15, S-17, S-18

Note: S-1, S-2, etc. = Initials of Research Subjects

According to the data in Table 1, 10 students fulfill the predictions of the procedural mathematical connection indicators on item 1, and 11 students fulfill the predictions of the procedural mathematical connection indicators on item 2. Seven students, identified as S-1, S-2, S-4, S-6, S-8, S-19, and S-20, confirmed both items. A few subjects fulfill item 1 but not item 2, specifically S-5, S-9, and S-17. Meanwhile, S-7, S-11, S-12, and S-16 are examples of subjects who fulfill item 2 but not item 1. Further, the following subjects did not meet the two items: S-3, S-10, S-S-13, S-14, S-15, and S-18. While the remaining students, S-7, S-11, S-12, and S-16, did not complete their assigned work on item 1, they did meet their assigned predictions on item 2. As a result, seven individuals fulfilled the predictions of procedural mathematical connection indicators. Specifically, S-1. S-2. S-4, S-6, S-8, S-19, and S-20, to name a few.

A final set of four criteria was used to select the subject, including (1) students who took a test on proportion material in direct and inverse proportion, (2) students who met the predictions of procedural mathematical connections, (3) students who were able to communicate, and (4) students who were willing to be interviewed. Afterward, an assessment is carried out based on the same work in groups that meet the predictions of mathematical connections in each item. Then a brief interview is conducted regarding their ability and communication skills, resulting in the selection of six students, who will be assigned to the subjects of S-2, S-4, S-6, S-8, S-19, and S-20, respectively. Student S-1 was one of the students who was not chosen as a subject of the study because of his lack of communication skills.

Based on telephone interviews conducted using the predictions of the assimilation-accommodation indicators that yielded the same answers, the classification of subjects who belong to the assimilation category was selected, including subjects with the initials S-19 and S-20, subjects who belong to the accommodation category were those with the initials S-4 and S-6, and subjects who belong to the assimilation-accommodation category were those with the initials S-19 and S-20. The classification of the two subjects was determined by the possibility of employing the constant comparative method (Creswell, 2017).

The following indicator predictions were used to divide subjects into three categories: assimilation, accommodation, and assimilation-accommodation.

(1) Prediction indicators of the assimilation process:

(a) if the student has the same or nearly the same experience as the instructions given;
(b) if the student adapts the new experiences, he gets the student's pre-existing schema structure;

(c) if the student can explain the proportion material he has obtained.

(2) Prediction indicators of accommodation process:
   (a) if the student's experience contradicts the stated instructions;
   (b) if the student modifies his or her internal schema to new facts acquired via experience in his or her surroundings;
   (c) if the student modifies their approach to the proportion test.

(3) Prediction indicators of the assimilation-accommodation process:
   (a) if the student is capable of taking the proportion test but is doubtful of the correct answer;
   (b) if the student can answer the test by combining between adjusting their previous experience and making modifications.

To validate the research data, a triangulation of sources based on the findings of the same or comparable work was performed to check every step in each procedure of the problem-solving process. The triangulation process was then extended by comparing test and interview results. The assimilation process followed the following framework: 1) being able to comprehend the problem, 2) being able to plan a solution, 3) being able to carry out the solution, and 4) being able to recheck the process of problem-solving.

The technique of collecting data was through tests with predictions of mathematical connection indicators for proportion materials in a direct and reverse proportion that were studied based on a procedural basis. Furthermore, interviews were conducted based on predictions of the assimilation and accommodation processes. To get the valid data, source triangulation was carried out by comparing the results of student work whose answers were identical. Then method triangulation was carried out by comparing test results with interview results.

The following steps were taken to complete the data analysis according to Creswell's phases (2017):

(1) Data reduction started with identifying relevant data using predictive indicators for the assimilation, accommodation, and assimilation-accommodation processes.

(2) The presentation of data was used to describe subjects classified into student work categories based on the formulation of predictive indicators for the assimilation, accommodation, and assimilation-accommodation processes.

(3) Triangulation of data was conducted through triangulation of sources and methods.

(4) Data interpretation was accomplished by comprehending the meaning of a series of data that has been presented about the assimilation process, the accommodation process, and the assimilation-accommodation process in a form that does not simply look at what is written, but rather interprets what and why is implied in the text.

RESULTS AND DISCUSSION

Research Results

The outcomes of the work of research subjects that fit into the category of assimilation process can be observed when they have the same or nearly the same experience as the instruction given and can adjust the new experiences they have with the current schema structure. As shown in Table 2, the following is a summary of how participants were classified based on the development of prediction indicators for the assimilation, accommodation and assimilation-accommodation processes.

Table 2. Summary of Subject Distribution Based on Test Results in the Assimilation Process, Accommodation Process, and Assimilation-Accommodation Process Categories

Test Items	Subject from Assimilation Process Category	Subject from Accommodation Process Category	Subject from Assimilation-Accommodation Process Category
1.	S-19, S-20	S-4, S-6	S-2, S-8
2.	S-19, S-20	S-4, S-6	S-2, S-8

1.1 The Assimilation Process of Subjects S-19 and S-20

Based on the student's work on item number 1, Subject S-19 wrote the answer procedurally, by writing what was known and asked about the proportion question. Subject S-19 started his work by converting the units from 72 km to 72.000 m, then writing the ratio of the amount of gasoline into the formula of direct proportion to the distance traveled by the car in the form of a ratio of $\frac{8}{32} = \frac{72.000}{Y^2}$. Subject S-19 immediately wrote the direct proportion formula, but the example with the symbol Y^2 was not explained. So, it is obtained that the distance that the car must travel is 288.000 m. This shows that the subject of S-19 did the work process with the

linking procedure systematically.

The following is an excerpt from the subject's response (S-19) on question 1 related to the direct proportion formula written in Figure 1, shown below.

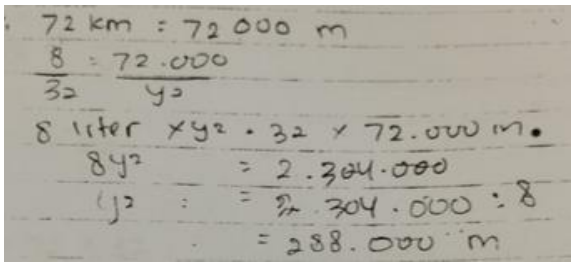

Figure 1. Subject S-19 Work

The formula written by subject S-19 in Figure 1 above demonstrates that the subject is familiar with the formula provided as a solution to the question by referring to a single symbol, namely Y^2, as the mileage.

The above-mentioned work's findings are corroborated by interview data. The following is an excerpt from an interview with the subject of S-19. (R = Researcher, S = Subject)

R : How could you the question about mileage?
S-1: Yes, because I had already known the formula of proportion when I was at elementary school,
and also it was taught when I was at the 7th grade, ma'am.
R : Could you explain what you remember from proportion material from the 7th grade?
S-1: As I know that there are two kinds of proportion, direct and inverse proportion, ma'am.
R : What step did you remember when you solve such kind of question/problem?
S-1: I firstly find the mileage using the formula of direct proportion
R : Then, how did you measure the mileage of the car?
S-1: I just simply write down the formula of direct proportion and did cross multiplication. Then I converted the *km* to *m*, and the final result was multiplied to 1000, ma'am.
R : What symbol is Y^2 ?
S-1: Y^2 is the mileage.
R : Why didn't you write it through exemplification?
S-1: No, ma'am, I just directly did it.

Based on the interview findings, there is a match with the test work, which indicates that to be able to answer questions of direct proportion material, S-19 employed a proportion formula that was previously learned when in elementary and junior high schools. Subject S-19 similarly wrote down the steps procedurally, however the example of the symbol Y^2 was omitted, yet subject S-19 could identify the rationale for the omission of the example correctly.

Both the S-19 subject and the S-20 subject can write a proportion formula in order to have a match between their respective works. $\frac{X^1}{X^2} = \frac{Y^1}{Y^2}$, but without putting a single instance of each symbol on the page. The subject of S-20, in addition, correctly replaced the amount of gasoline and the given distance into the proportion calculation using the correct technique, yielding a value of 288.000 m. In this instance, the subject of S-20 changed the distance unit from kilometers (km) to meters (m). The following is a sample of the work done by the S-20 subject depicted in Figure 2.

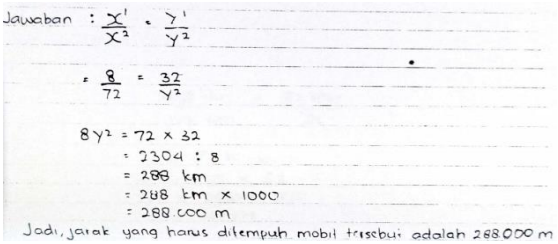

Figure 2. Subject S-20 Work

The findings of the interview on item 1 help to clarify the work of the S-20 subject. An excerpt of the interview with the S-20 subject is included below.

R : How could you do the test of item 1?
S-20: I distinctly remember with the material when I was at elementary school, ma'am.
R : What was that?
S-20: The formula of direct proportion, ma'am.
R : Did the formula that you write ($\frac{X^1}{X^2} = \frac{Y^1}{Y^2}$) is correct?
S-20: yes, ma'am.
R : Are you sure?
S-20: Sure, Ma'am.
R : Please exemplify the symbol that you wrote and explain!
S-20: X^1 is the amount of gasoline if the mileage is 72km, X^2 is the amount of gasoline for the inquired mileage, Y^1 is the known mileage, and Y^2 is the inquired mileage, Ma'am.

R : Are you sure with your answer?
S-20: Yes, Ma'am.
R : Okey, What about the What about the units of km that are not converted into units of m?
S-20: I immediately multiply it in the final result, ma'am.
R : Okey.

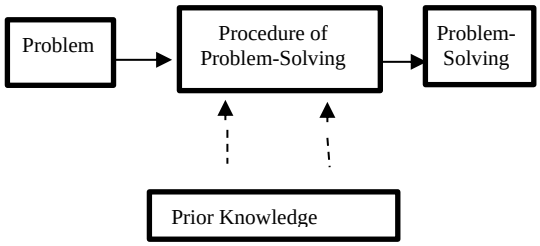

Figure 3. The Illustration of Assimilation Process

The assimilation process illustrated in Figure 3 above may be summarized as follows: when a subject learns an issue, they have prior knowledge from elementary school with the same or comparable difficulties to carry out the first solution process by connecting each component (known as problem solving planning). The subject then completes the following procedure by connecting the other components with their prior knowledge of mathematical ideas that they already possess to arrive at the final conclusion. At some point throughout the final result calculation, the subject double-checked their response against the problem they were solving. This included altering the unit of measurement and division and multiplication used to determine the final result.

1.2 The Accommodation Process of Subjects S-4 and S-6

Based on the students' work on item number 1, Subjects S-4 and S-6 wrote down, procedurally, what was known and asked from the proportion question. Subject S-4 started his work by writing directly "amount of gasoline : amount of gasoline = j. mileage : j. mileage" then followed by writing a form like this "8 liter:32 liter=72 km; X km shows the subject of S-4 can modify the writing of the direct proportion formula equal to the horizontal form through the colon division symbol, but the term or sentence designation uses the same term, "the amount of gasoline divided by the amount of gasoline" is then equal to "mileage divided by the mileage". This writing shows that the subjects were trying to modify the identified components directly, but it is meaningless based on the identified components. Procedurally, it shows a modification of the work adapted to what is known, but the written procedure is not quite right. Subjects S-4 can modify the proportion work by immediately writing in modified form based on their thoughts, but there is an error in the procedure for obtaining the changes, but the results are correct. The following is a screenshot of the work of S-4.

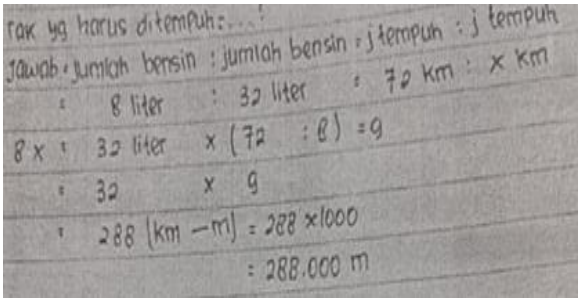

Figure 4. The Subject S-4 Work

S-6, on the other hand, begins by dividing the distance by the amount of gasoline used ($\frac{72km=}{8l} = 9km/l$), multiplying that result by the total amount of gasoline used (32l9km=288km) to arrive at the answer. Although there appears to be an error in the unit multiplication procedure in this working procedure, the subject of S-6 appears to write the final result and units correctly. The subject S-6 then converted the unit by multiplying 1000 m (288 x 1000) and precisely as 288.000 m. This demonstrates that the subject of S-6 carries out the working procedure with the linking in a coherent manner, despite the fact that the multiplication procedure contains units whose writing is incomplete. The following screenshot is from the work of the S-6 subject depicted in Figure 5.

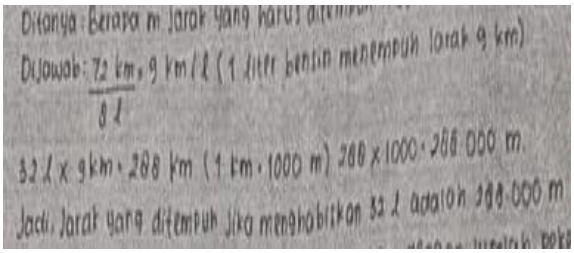

Figure 5. The Excerpt of Subject S-6 Work

The following is an excerpt from interviews with the subjects of S-4 and S-6, conducted as follows.

R : How could you answer the question?
S-4: I firstly looked at the question, Ma'am.
R : Yes, so?

S-4: I answered it based on the requirement, which was about the mileage of the car.
R : Then?
S-4: I directly divided the amount of gasoline from the shortest distance divided by the whole amount of gasoline, Ma'am.
R : Next?
S-4: It would be the same with the proportion of mileage, Ma'am.
R : Explain more!
S-4: Then, I did the multiplication and division process.
R : Is it like that?
S-4: Yes, Ma'am.
R : Okey, Thanks.

Furthermore, the following is an excerpt from an interview with the subject of S-6:
R : How could you answer the question?
S-6: I saw the storyline in the question, first, Ma'am.
R : Explain more, please!
S-6: I divided the mileage by the amount of gasoline needed.
R : Then?
S-6: Then, the result was multiplied by the amount of gasoline needed to go through the longest distance; then, I converted the unit into a meter.
R : Is it right?
S-6: Yes.
R : Okey, then.

Based on the findings of interviews conducted with both subjects S-4 and S-6, it is able to ascertain the conformity of the interview responses with their respective work. In carrying out the working procedure, the two individuals applied modified new information gained from the problems encountered in item 1. Both subjects wrote directly from the material without recalling previous knowledge, though there were some inaccuracies in writing the procedure's units. Both individuals had the proper final findings and units, but their methods were distinct, with adjustments for subjects S-4 and S-6. The two participants' accommodation processes are depicted in Figure 6 below.

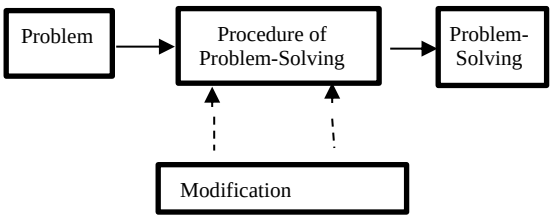

Figure 6. The Illustration of Accommodation Process

1.3 The Assimilation-Accommodation Process of Subjects S-2 and S-8

The following figure is a screenshot of the S-2 subject's work:

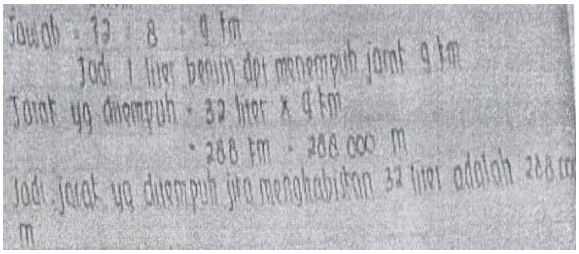

Figure 7. The Excerpt of Subject S-2 Work

The S-2 subject's task is to write the known mileage directly, then calculate the unknown mileage by multiplying the result by 32 liters of gasoline and changing the unit by multiplying 1000.

Furthermore, the work of the S-8 subject is presented in Figure 8 below.

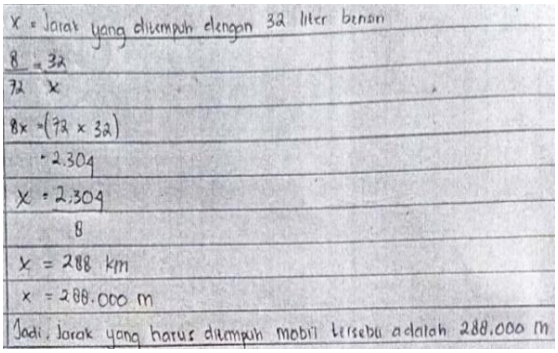

Figure 8. The Excerpt of Subject S-8 Work

The workpiece of subject S-8 above illustrates the procedure by utilizing the variable x to represent the car's mileage in question and then multiplying by 1000 to convert the units.

Based on the findings of the S-2 and S-8 subjects' work, it is clear that the two individuals exhibit a similar inclination to alter the solving procedure by using a symbolic comparison formula with various variables. In Item 1, subject S-8 uses a variable x to determine the car's mileage, whereas subject S-2 determines the car's mileage directly for one liter of gasoline. Then, using the operating technique, subjects S-2 and S-8 obtained 288 km and converted it to meters by multiplying by 1000.

In addition, interviews were performed with both subjects S-2 and S-8, which are reported in the following excerpt.

R : How did you do this question of proportion?
S-2: I directly divided the longest distance with the amount of gasoline needed. This means 1 liter of gasoline is for 9 km.
R : What about the asked mileage?
S-2: I multiplied it by the amount of gasoline, then I converted its units.
R : What was the result?
S-2: 288.000 m, Ma'am.
R : Are you sure?
S-2: Yes.

The following is an excerpt from the interview with S-8:

R : How about your work?
S-8: This one, Ma'am. I directly made a formula of direct proportion between the known mileage with the amount of gasoline. Also, the amount of gasoline with the asked mileage. Then, I did cross multiplication and divided it, and I got 288 km. At last, I multiplied it by 1000.
R : Are you sure?
S-8: Yes.

After interviewing the two subjects, it was discovered that they tend to alter their processes when faced with new information. This is supported by the findings of the interviews with the two subjects.

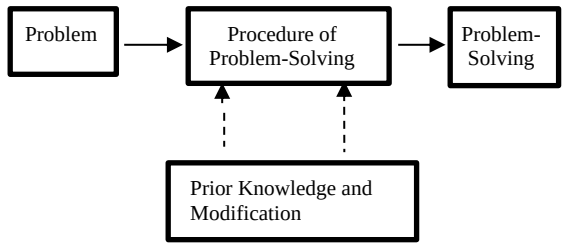

Figure 4. The Illustration of Assimilation-Accommodation Process

In the assimilation-accommodation process carried out by both S-2 and S-8 subjects, it was discovered that prior knowledge of proportion had the potential to assist in the modification of problem-solving methods.

The research participants demonstrated a sequence of steps that could aid the subject in addressing new issues based on the three: assimilation processes, accommodation processes, and assimilation-accommodation processes. Subjects with extensive prior knowledge (past knowledge) can assist in simplifying the modification of new problems. While the capacity to adapt on its own can assist in addressing new problems, the problem-solving method has the potential to be inaccurate. Additionally, subjects who possess necessary basic information but cannot alter their prior knowledge run the risk of making an error when attempting to solve procedures and vice versa.

The findings of this study indicate that the two subjects having undergone stages of assimilation of the proportion concept taught in elementary school, as indicated by their writing down the work, beginning with correctly writing the formula for the symbolic form of proportion to carry out the problem-solving process. In contrast, the two participants demonstrated the accommodation process by changing their knowledge differently from the formula written in the assimilation group to complete the solution procedure. Both subjects' assimilation-accommodation processes demonstrated a tendency to modify new problems using prior knowledge by writing proportion formulas into distinct problem-solving procedures with assimilation groups and accommodation groups represented by formulas and the process of solving them appropriately. The findings of this study suggest that the assimilation-accommodation process could assist in accelerating up the problem-solving process when prior knowledge is well acquired.

Discussion

Kurniawan et al. (2017) found that the assimilation process tends to use prerequisite knowledge to carry out problem-solving procedures. Based on the findings of this research, it is concluded that students can comprehend problems, formulate problem-solving plans, carry out problem-solving plans that have been planned, and recheck the answer. In addition, subjects who participate in the assimilation process can use problem-solving strategies developed in the previous step based on prior knowledge, according to a study conducted by Sopamena et al. (2018) in accordance with Piaget's theory known as the schema stage.

While subjects with a tendency to modify new knowledge without recalling prior knowledge can carry out the accommodation process, this is consistent with Kurniawan et al. (2017) who state that when students carry out problem-solving plans that have been planned by amending based on knowledge about the problems at hand. When students encounter flaws in re-examining

responses, they cannot complete the accommodation process described by Kurniawan et al. (2017). According to Kurniawan et al. (2017), the accommodation process demonstrates that students can make plans for solving the problems given in accordance with what is known from the problem (such as trying to make plans on other paper or performing other work steps), and this result is consistent with their findings. However, Wahyudi et al. (2018) noted that in order to ensure that the accommodation process runs well and that difficulties are resolved, it was important to increase students' conceptual understanding through the scaffolding process.

Students can carry out the assimilation-accommodation process by changing data gathering with the new knowledge they acquire while completing various problem-solving procedures with the assimilation and accommodation subject groups. According to Yogi (2018) this allows students to apply previously taught principles and create adjustments to aid problem-solving independently. According to Kurniawan et al. (2017), students show a proclivity for problem-solving that is not often done. Meanwhile, Dorgo's study (2019) found that the process of assimilation and accommodation may be utilized to develop a framework for generalization. The findings of this study show that participants who are capable of carrying out the assimilation-accommodation process concurrently with problem-solving can significantly accelerate the solving of newly encountered difficulties if prior knowledge is effectively acquired.

CONCLUSION

The conclusion drawn from the findings of this study is that the two subjects of the assimilation process begin with the creation of a formula for a symbolic form of proportion with the correct form of information (prior knowledge) in elementary school to facilitate the problem-solving process. In contrast, the two subjects carried out the accommodation process by demonstrating the modification of their knowledge in a different form from the formula written as in the assimilation group to complete the process of problem-solving correctly. The two subjects of the assimilation-accommodation process demonstrated a tendency to modify new problems through prior knowledge by writing proportion formulas into different solving procedures with the assimilation group and the accommodation group. Based on the current findings of this study, it is indicated that the assimilation-accommodation process can assist in accelerating the problem-solving process when dealing with new information if that prior knowledge has been thoroughly learned.

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REFERENCES

Businskas, A. M. (2008). Conversations about connections: How secondary mathematics teachers conceptualize and contend with mathematical connections. *Thesis*, Simon Fraser University, Barnaby, Canada.

Creswell, J.W. (2017). "*Research Design (Pendekatan Metode Kualitatif, Kuantitatif, dan Campuran)".* Yogyakarta: Pustaka Belajar.

Dorko, A. (2019). Generalization, Assimilation, and Accommodation. *The Mathematics Educator*, 28(2): 33–51. https://files.eric.ed.gov/fulltext/EJ1239071.pdf.

Jalan, S., Nusantara, T. Subanji. Chandra, T.D. 2016. Students' Thinking Process in Solving Combination Problems Considered From Assimilation and Accommodation Framework. *Educational Research and Reviews*, *11*(16): 1494-1499. DOI: 10.5897/ERR2016.2811.

Kosasih, N.Z., Supratman, & Hermanto, R. 2018. Analisis kesalahan peserta didik dalam menyelesaikan soal pemecahan masalah pada materi aljabar berdasarkan teori Jean Piaget. *Jurnal Penelitian Pendidikan dan Pengajaran Matematika*, *4* (1): 35–46.

Kurniawan, E., Mulyati, S., & Rahardjo, S. (2017). Proses Asimilasi dan Akomodasi dalam Memecahkan Masalah Matematika Berdasarkan Kecerdasan Emosional. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *2*(5): 592-598. http://journal.um.ac.id/index.php/jptpp/.

Lahinda, Y., Jailani. (2015). Analisis Proses Pemecahan Masalah Matematika Siswa Sekolah Menengah Pertama. *Jurnal Riset Pendidikan Matematika*, *2*(1): 148 -161.

Ningrum, H.U., Mulyono, Isnarto, Wardono, (2019). Pentingnya Koneksi Matematika dan Self-Efficacy pada Pembelajaran Matematika SMA. *PRISMA, Prosiding Seminar Nasional Matematika, 2*: 679-686.

Rossydha,F.(2017). Profil Berpikir Relasional Siswa Dalam menyelesaikan Masalah pada Operasi Aljabar Ditinjau Dari Kemampuan Akademiknya di Kelas VIII MTsN Karangrejo Tulungagung. *Skripsi*, IAIN, Tulungagung.

Rutherford, D. G. (2011). A Model of Assimilation and Accommodation in the Cognitive & Cultural Realms. *Dynamical Psychology*. Retrieved from: http://dynapsyc.org/ 2011/Rutherford_2011.pdf.

Singletary, L. M. (2012). Mathematical connections made in practice: An examination of teachers' beliefs and practices. (Unpublished dissertation). Athens, GA: University of Georgia.

Sopamena, P., Sangkala, N.S., Rahma, F.J. (2018). Proses Berpikir Siswa Dalam Memecahkan Masalah Matematika Berdasarkan Teori Piaget Pada Materi Program Linear di Kelas XI SMA Negeri 11 Ambon. "*Prosiding SEMNAS Matematika & Pendidikan Matematika,"* IAIN, Ambon, Feb. ISBN 9 786025 185700, pp. 83-92.

Suominen, A. L. (2015). Abstract Algebra and Secondary School Mathematics: Identifying And Classifying Mathematical Connections. *Dissertation.* Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree. Doctor Of Philosophy. Athens, Georgia.

Wahyudi, Waluya, S.B, Rochmad, Suyitno, H. (2018). Assimilation and Accommodation Processes in Improving Mathematical Creative Thinking with Scaffolding According to Learning Style. *Journal of Physics Conference Series*, *1097*(1): 012156.

Yogi, A. (2018). Proses Asimilasi dan Ako-modasi Mahasiswa Bergaya Kognitif Field Independent Dalam Menyelesaikan Masalah Geometri. *Prosiding Seminar Nasional*, Universitas Cokroaminoto, Palopo, *4*(1): 394-403. ISSN 2443-1109.