

Analysis of the Visual to Verbal Mathematical Representation Process for Junior High School Students in Solving HOTS Questions in terms of Adversity Quotient

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Abstract

Representation is a tool to solve a problem in the form of interpretation of what students think of a problem in the form of visual, verbal, and algebraic or symbolic representations. Solving non-routine problems in mathematics learning requires high order thinking skills (HOTS). Solving student problems, both routine and non-routine problems can be influenced by the ability of students to process existing problems into a challenge that must be passed, which is called Adversity Quotient. The purpose of this study was to describe the process of visual to verbal mathematical representation of junior high school students in solving HOTS questions in terms of the adversity quotient. The research uses a qualitative approach, the type of research used in this research is descriptive qualitative research. The data obtained in the form of written test results data, questionnaire results data and interview data will be submitted in written or oral form in narrative form. The instruments used are in the form of tests and questionnaires. The result show that the subject representation process with the adversity quotient level for the climber category has met the representation process indicators well in the three HOTS questions that were worked on. Subjects with the adversity quotient level in the camper category have not been able to meet the indicators of the representation process in the HOTS problem of creating.

Keywords: representation process; high order thinking skill; adversity quotient

INTRODUCTION

Mathematics learning has a standard process, one of which is representation (NCTM, 2000). The purpose of learning mathematics requires students to have skills in representation, as contained in Permendikbud Number 35 of 2018 attachment 3 regarding the guidelines for SMP/MTS subjects, namely understanding mathematical concepts, to achieve these skills one of the indicators is expressing concepts in various forms of mathematical representation. Using representations in various forms, both visually, verbally, and symbolically is referred to as the ability of multiple representations (Sa'diyah, et al., 2020). Students can communicate mathematical ideas, translate mathematical problems into one form of representation, and mathematical modeling through the representation process (NCTM, 2000). The mathematical representation process has four stages of the process, namely: Unpacking the source, Preliminary coordination, Constructing the target, Determining equivalence (Bossé, et al, 2014). Unpacking the source process is indicated by activity read and investigate the forms of visual

representations presented, writing down mathematical ideas or ideas is indicated as a preliminary coordination process, then constructing the target is indicated by the process of using written mathematical ideas to find solutions, and the determining equivalence process is indicated by evaluating solutions. (Bossé, et al, 2014).

Solving non-routine problems in mathematics learning requires high order thinking skills (HOTS) (Susanto & Retnawati, 2016). High order thinking skills (HOTS) are located at the levels of analyzing (C4), evaluating (C5), and creating (C6) (Krathwohl, 2017). Solving student problems, both routine and non-routine problems can be influenced by the ability of students to process existing problems into a challenge that must be passed, referred to as Adversity Quotient (AQ). (Widyastuti, 2015). Adversity Quotient (AQ) was introduced by Stoltz (2000) as a person's intelligence or fighting power in dealing with the problems that confront him. Adversity Quotient (AQ) can be used as a measure of how strong a person is in surviving the challenges that exist. Stoltz categorizes Adversity Quotient (AQ) into three categories, namely low AQ (quitter), moderate AQ (camper), and high AQ (climber).

The implementation of representation is not a simple thing even though representation is one of the standard processes in learning. In fact, the student's representation ability is still not optimal as stated Rahmawati (2015) in his research, that teachers consider representation only used as a complement in learning and often students receive knowledge from teacher to student or only in one direction, besides that in learning mathematics some students only memorize formulas without analyzing problems. In line with Hernawati (2016) that direct study habits lead to low student representational abilities. Research conducted by Murtianto, et al, (2019) shows that only students with high learning motivation categories are able to perform verbal representations well, while students with moderate and low learning motivation have not been able to do so. Research conducted Rahmawati, et al., (2015) shows the development of language from visual problems to the cause of visual to verbal representations indicated by words or written texts that students do not develop significantly. Therefore, further research is needed on verbal representation in solving visual problems to describe the process of visual to verbal mathematical representation of students. This study aims to describe the process of visual to verbal mathematical representation of junior high school students in solving HOTS questions in terms of Adversity Quotient.

RESEARCH METHOD

The research uses a qualitative approach, the type of research used in this research is descriptive qualitative research. The data obtained in the form of written test results data, questionnaire results data and interview data will be submitted in written or oral form in narrative form. The research was conducted at SMPN 2 PACET which is located at Wiyu Village, Kec. Pacet Kab. Mojokerto, East Java. The subject is a class VIIa student of SMPN 2 Pacet. The research procedure starts from the preparation stage, implementation stage, and the stage of compiling a research report. The preparation stage starts from compiling research proposals, compiling instruments and validating instruments to asking for permission and making agreements with subject teachers regarding research techniques. The

implementation stage starts from distributing questionnaires, distributing adversity quotient questionnaires to the class that has been determined, then a HOTS test will be given. After the test is done, the researcher selects students with different adversity quotient levels and with consideration of the test results that allow them to be analyzed. After the test and interview data obtained, the researcher will analyze the data that has been obtained to describe the process of visual to verbal mathematical representation of junior high school students in solving HOTS questions in terms of the adversity quotient. The next stage is compiling a research report and describing it based on the research objectives. The researcher selected students with different adversity quotient levels and with consideration of test results that allowed them to be analyzed. After the test and interview data obtained, the researcher will analyze the data that has been obtained to describe the process of visual to verbal mathematical representation of junior high school students in solving HOTS questions in terms of the adversity quotient. The next stage is compiling a research report and describing it based on the research objectives. The researcher selected students with different adversity quotient levels and with consideration of test results that allowed them to be analyzed. After the test and interview data obtained, the researcher will analyze the data that has been obtained to describe the process of visual to verbal mathematical representation of junior high school students in solving HOTS questions in terms of the adversity quotient. The next stage is compiling a research report and describing it based on the research objectives.

The instruments used are in the form of tests and questionnaires. Questionnaires are used to measure the adversity quotient category of students while the test is to collect data on students' visual to verbal mathematical representation abilities. Data analysis carried out in this study consisted of analysis of the results of the written test about HOTS, analysis of adversity quotient questionnaires and analysis of interview results. Adversity quotient analysis data obtained from the questionnaire will be given a score for each item, then find the value *Adversity Response Profile (ARP)* with ARP formula = $(C+O+R+E)*2$. The data from the interviews will be analyzed by the researcher as a reinforcement of the student's answers and as a cross check of the suitability of the student's answers with what students actually think. The results of the entire analysis process regarding the ability to represent and the level of adversity quotient will then be concluded descriptively based on the data found during the analysis process.

RESULTS AND DISCUSSION

The results of the questionnaire that have been calculated are 7 students belonging to the climber category, 4 students belonging to the camper category and 11 students belonging to the climber transition category, and no students belonging to the quitter category. Data reduction was carried out in the climber transition category so that the adversity quotient level for the climber and camper categories was obtained to be studied. Next, two groups were formed consisting of two

students each based on the existing adversity quotient level. Each student is selected based on the results of the test answers that allow for analysis.

Table 1. Research Subject Group

Group	Category	Student Code
1	<i>Climber</i>	AZA and ARW
2	<i>Camper</i>	AF and DGA

The process of visual to verbal mathematical representation of students in working on HOTS questions from each research subject based on the stages of the unpacking the source representation process in HOTS analysis questions is almost the same, namely by paying attention to the images presented and reading the questions repeatedly. The characteristics shown by the subjects in the HOTS evaluation questions began to show differences between climber and camper subjects. The camper subject marked or scribbled on the questions and pictures presented, while the climber subject only paid attention to the picture and read it over and over again. The characteristics shown by all subjects in the HOTS questions are almost the same, namely paying attention to pictures and reading the questions presented.

The process of visual to verbal mathematical representation of students in working on the HOTS questions from each research subject based on the stages of the preliminary coordination representation process in the HOTS analysis problem is not too significant, the difference is only shown by DGA (camper) which does not write down the universe of sets, DGA writes 3 sets that can be formed from the picture presented and AZA (climber) which replaces the hypunan name by using capital letters. The characteristics shown by the two groups of subjects in the HOTS evaluation questions are very clear, the difference is that the camper category subjects are slightly more complete in writing answers in the form of set operations from Venn diagrams and the intended set from the images presented. The difference is also very clear in the matter of creating HOTS. The two camper subjects have not succeeded in making a collection from the presented images, while the climber subject has succeeded in making a collection from the presented images. The process of constructing the target carried out by the four subjects showed the difference in working on the HOTS questions to create. As a result of the incomplete preliminary coordination process, the set created cannot be operated correctly according to the order of the questions. Subjects in the climber category showed that they had carried out the determining equivalence process, while the subjects with the camper category D only carried out the determining equivalence process in the HOTS analysis and evaluation questions, while in the HOTS questions, the subjects in the camper category did not give a final answer, which means the camper subjects had not had time to re-examine. the result of the work. while the subject of the climber has succeeded in making a collection of the images presented.

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The representation process is carried out through four stages of the representation process by Bossé, et al., (2014) namely unpacking the source,

preliminary coordination, constructing the target, and determining equivalence. Based on the results of the HOTS test questions given to subjects with different adversity quotient categories, namely climbers and campers, it was found that there were differences in the verbal representation process of visual questions performed by climber and camper subjects. The unpacking the source stage requires the subject to carry out HOTS analysis activities, the difference can be seen from the camper subject, in addition to observing and reading the questions repeatedly, the camper subject also gives a mark on the HOTS evaluation questions, while students from the climber category do not give any marks on the questions presented, but just look at the pictures and read the questions over and over again.

Preliminary Coordination or coordinating initial understanding is shown by compiling, adjusting, or organizing the initial understanding that students already know. Subjects with the categories of climbers and campers at this stage perform HOTS activities to plan ideas to solve problems from the initial understanding that has been obtained from the unpacking the source stage. In the HOTS question, the analysis of the climber and camper subjects has succeeded in determining the set and not the set from analyzing the presented images. In the HOTS questions, the evaluation of the climber and camper subjects has succeeded in determining the set and not the set by comparing the two images presented in the problem. In the HOTS question, the subject of the camper has not been able to make a set according to the image presented in the question. The activities shown by the students from the three questions indicate the activity of creating initial understanding to solve problems. This is in line with the research of Ahmad, et al., (2020) that in the preliminary coordination and constructing stages of the target students carry out HOTS activities in the form of creating. Subjects in the camper category who have not been able to carry out the preliminary coordination process in working on the HOTS questions from the interview results which show that the two camper subjects feel confused and feel that the time given is still not enough, indicating that the two camper subjects are constrained in writing what the subject thinks or are constrained in language. This language barrier is in line with research conducted by Rahmawati, et al.,

Based on the results of research conducted by the subject in the process of constructing the target, which is indicated by the activity of operating the set that has been found in the HOTS analysis problem, operating the set that has been determined in the HOTS evaluation question, operating the set that has been created in the HOTS problem creating. The HOTS activities in the constructing the target stage are the same as those in the preliminary coordination stage, namely creating. Subjects in the climber and camper categories were able to construct the target representation on the HOTS analysis and evaluation questions, while in the HOTS questions creating camper subjects they had not been able to do so. This is because at the preliminary coordination stage the camper subject only made two of the four requested sets. From the results of the work and interviews with the camper subject, it can be seen that the ability to analyze and evaluate the camper subject is still lacking. The ability to analyze and evaluate is closely related to the ability to create. This is in line with the research of Kurniati, et al., (2016) that creative ability is

influenced by analytical and evaluation abilities which can result in low creative abilities if analytical and evaluation abilities are also low.

The process of determining equivalence which is marked by the activity of giving the final answer or re-checking the answers and the results of the work is carried out well by the subject of the climber in the three HOTS questions that are worked on. The subject only carried out the process of determining equivalence in the HOTS analysis and evaluation question, in the HOTS question creating the camper subject did not do it. The difference from the representation process carried out by subjects with the categories of climbers and campers in working on the HOTS questions in this study began to be seen in the HOTS questions creating. An incomplete preliminary coordination process can be caused by the unpacking the source process, namely unpacking the source from the initial representation that is not optimal. The subject is less than optimal in disassembling the source due to the students' HOTS ability in analyzing, evaluating, and creating problems presented in pictures and questions to explore information is still lacking. This is in line with research conducted by Sa'diyah, (2020) which examined the translation of visual to verbal representations which also showed that the subject had not been able to extract information from the problems presented in the questions. Other research conducted by Ahmad (2020); Bal (2014); Biber (2014); Bal (2015); Rahmawati, et al. (2017) also shows that there is still a lack of translation ability between representations. Based on this research, it is hoped that it can be used by teachers as material for consideration in the preparation of learning designs that are in accordance with the characteristics of students in working on HOTS questions.

CONCLUSION

The subject representation process with the adversity quotient level for the climber category has met the representation process indicators well in the three HOTS questions that were worked on. Subjects with the adversity quotient level in the camper category have not been able to meet the indicators of the representation process in the HOTS problem of creating. The ability of HOTS analysis and evaluation affects the ability to create the camper subject so that the information contained in the HOTS creation question cannot be extracted optimally. Digging up information from the questions presented which can be categorized as unpacking the source activity is not done well by the camper subject in working on creating HOTS questions. This affects the subsequent representation process.

The process of building initial understanding and constructing target representations requires the ability to create HOTS. This process is characterized by the activity of constructing an initial understanding by making sets based on the images presented and operating the sets that have been made based on the set operations that have been instructed in the HOTS problem to create cannot be done properly because the camper subject is constrained in translating what he thinks into words. written, or in other words constrained in language. The findings in the

study show that the ability of HOTS analysis and evaluation affects the ability of HOTS to create, and the ability of HOTS to create requires language skills as a tool in the process of visual to verbal representation. This process is characterized by the activity of constructing an initial understanding by making sets based on the images presented and operating the sets that have been made based on the set operations that have been instructed in the HOTS problem to create cannot be done properly because the camper subject is constrained in translating what he thinks into words. written, or in other words constrained in language.

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