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# Analyzing students' character values in non-routine mathematics problems

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**Abstract.** This research is a descriptive qualitative research that aims to determine the character value of senior high school students which includes the value of honesty, hard work, creative, and curiosity in solving non-routine mathematics problems. Methods of data collection are done by written test consisting of three non-routine mathematics problems about systems of linear equations with three variables, observation of student character values during the test, then continued with the interview that aims to ensure the correctness of test sheet analysis results and observation analysis results. Based on the results of the analysis it is known that when solving non-routine problems, students show the character value of honesty, hard work, creative, and curiosity, with curiosity character values as the dominant character and honesty values as rarest characters.

## 1. Introduction

Currently, Indonesian education system runs in accordance with the 2013 curriculum's criteria which are promoting Character Strengthening as a movement under the responsibility of the educational unit to strengthen the character of the students [1,2]. Character education serves to improve the ability and form national character not only in order to educate the life of the nation but also the basic values and character [3,4]. It can be said that character values are an important aspect to be considered in Indonesian education at this time.

The reality is opposite. In fact, even though there are some schools that already have an awareness of how important the character education, but unfortunately it is founded that the assessment of character education is still less attention [5]. Character values education also needs help from the family, school, and community environment, but nowadays character values are still ignored and prioritize the development of intelligence [3]. Based on some of the facts above, it can be said that character education in Indonesia is still less attention especially in the aspect of character education assessment. In mathematics education, there are three values that are the focus and attention, which one of them is the value of public education or that we know as a character value [6].

In mathematics values related to public education is the value of honest, creative, hard work, and curiosity [7]. The value of the character not only be applied in the learning process but also in the process of completing a mathematics problem, including on non-routine problems [8,9]. Non-routine problems are the kind of problems which are most appropriate for developing mathematical problem-solving and reasoning skills, and the ability to apply these skills in real-life situations [10]. It is known that character education produces character values that are important for students to have during learning. From



previous research, it is also known that character values can be applied in aspects of assessment, for example in the provision of non-routine problems which in fact during this time the assessment of character values is still less attention [8]. Based on all the literacy above, the researcher conducted this study aimed to look at the value of the character (honesty, hard work, creativity, and curiosity) that appears when senior high school students in doing non-routine mathematics problems.

## 2. Methods

Type of this research is a qualitative descriptive study which aims to describe the character value of student in doing non-routine mathematics problems. This research was conducted in the odd semester of 2017/2018 school year at Sriwijaya Negara Senior High School Palembang. The focus of this study is the character value of senior high school students when doing non-routine problems, among others: the value of honest, hard work, creative, and curiosity. The selection of subjects in this research was carried out purposively by considering several desired criteria. Three criteria are used as a consideration in the selection of samples, including: (1) the level of education is the same; (2) teacher's recommendation; (3) student willingness. The procedures of this study include: (1) the preparation phase, prepare research instruments and observations related to schools and classes that will be used as research subjects; (2) the research phase, the subject class was given a written test material about three variables of linear equations and observations related to the character of the students during the test, based on the results of the analysis test sheet and observation, conducted interviews to the subject to ensure the correctness of the data obtained previously; (3) data analysis phase, data analysis is carried out from test results, observations, and interviews. Data analysis techniques used in this study include: (1) data reduction; (2) presentation data, and; (3) conclusion.

## 3. Results and Discussion

Based on the results of the analysis, it is known that while working on non-routine mathematics questions the subject tends to show the value of the character of honesty, hard work, creativity, and curiosity.

### 3.1 Honesty Character.

The analysis begins by looking at the observations of the character values of each subject when solving non-routine problems. The results of observations of high-class subjects (Figure 1) and middle-class (Figure 2) are showing if they show the emergence of honesty values indicator when completing non-routine mathematics questions.

No.	Aspek yang diukur	Ya	Tidak
1.	Siswa tidak membuka buku catatan atau cetak saat tes.	✓	
2.	Siswa tidak menyalin pekerjaan teman	✓	
3.	Siswa tidak mudah menyerah mengerjakan permasalahan yang sedikit sulit dikerjakan dengan menyelesaikan setiap permasalahan hingga menemukan penyelesaian yang tepat.	✓	
4.	Siswa mengerjakan seluruh permasalahan yang diberikan meskipun belum sampai langkah terakhir	✓	
5.	Siswa memecahkan masalah dengan berbagai strategi pemecahan masalah.		✓
6.	Siswa memberikan jawaban lain bagi soal yang memiliki banyak jawaban		✓
7.	Siswa menggunakan minimal dua sumber belajar untuk membantunya menyelesaikan permasalahan yang diberikan.	-	
8.	Siswa bertanya jika ada pertanyaan yang tidak dipahami.	✓	

Figure 1. High-class subject observation sheet

No.	Aspek yang diukur	Ya	Tidak
1.	Siswa tidak membuka buku catatan atau cetak saat tes.	✓	
2.	Siswa tidak menyalin pekerjaan teman	✓	
3.	Siswa tidak mudah menyerah mengerjakan permasalahan yang sedikit sulit dikerjakan dengan menyelesaikan setiap permasalahan hingga menemukan penyelesaian yang tepat.	✓	
4.	Siswa mengerjakan seluruh permasalahan yang diberikan meskipun belum sampai langkah terakhir	✓	
5.	Siswa memecahkan masalah dengan berbagai strategi pemecahan masalah.		✓
6.	Siswa memberikan jawaban lain bagi soal yang memiliki banyak jawaban		✓
7.	Siswa menggunakan minimal dua sumber belajar untuk membantunya menyelesaikan permasalahan yang diberikan.	-	
8.	Siswa bertanya jika ada pertanyaan yang tidak dipahami.	✓	

Figure 2. Middle-class subject observation sheet

Based on the results of observations the value of low-class characters is known if when resolving non-routine problems the subject does not show indicators of honesty values. Figure 3 below will show the results of analyzing low-class subject observation sheets when solving non-routine mathematics problems.

No.	Aspek yang diukur	Ya	Tidak
1.	Siswa tidak membuka buku catatan atau cetak saat tes.	✓	
2.	Siswa tidak menyalin pekerjaan teman		✓
3.	Siswa tidak mudah menyerah mengerjakan permasalahan yang sedikit sulit dikerjakan dengan menyelesaikan setiap permasalahan hingga menemukan penyelesaian yang tepat.		✓
4.	Siswa mengerjakan seluruh permasalahan yang diberikan meskipun belum sampai langkah terakhir		✓
5.	Siswa memecahkan masalah dengan berbagai strategi pemecahan masalah.		✓
6.	Siswa memberikan jawaban lain bagi soal yang memiliki banyak jawaban		✓
7.	Siswa menggunakan minimal dua sumber belajar untuk membantunya menyelesaikan permasalahan yang diberikan.	-	
8.	Siswa bertanya jika ada pertanyaan yang tidak dipahami.		✓

Figure 3. Low-class subject observation sheet

Based on the data from the analysis of the observation sheet, the interview was continued to ensure the correctness of the data. When interviewing the subjects of high-class and middle-class being able to explain step-by-step answers that they have written, so it is assumed that when resolving non-routine problems, subjects of high-class and middle-class has emerged the honesty character value. The assumption was also supported by the answers of high-class subjects when the researcher asked why they did not see the work of other students, the subject replied "*if I cheat it can make me not understand, so it is better to look for myself first*". The same statement was also conveyed by middle-class subject who stated, "*I can not do that because this is test, it's better to answer as much as I can*". But a different statement was delivered by another middle-class subject who stated, "*I don't want (cheating). I better*

*ask how to solve it with friends*". The middle-class subject tends shows the character value of honesty because they want to answer the problem with their own abilities, but there are also those who do not show the honesty value that is marked by asking how to solve it with friends when he should not ask friends. Other the statements conveyed by low-class subjects, during the interview the subject tends to be unable to explain the steps of the answers she wrote and stated, *"I see the answers of friends"*. The statement supports the initial assumption which states that if a low-class subject does not give rise to honesty character values when solving non-routine problems. When the researcher asked the reason why she copied the work of a friend, a low-class subject replied *"because I don't understand what I have to answer"*. Based on this opinion it is known that the reason for not appearing honesty character values is due to the lack of the subject's ability to solve the problems given. Based on the results of the analysis above, it can be said that the value of honesty characters only appears in high-class and middle-class subjects but does not appear in low-class subjects when resolving the problems given.

### 3.2. Hard Work Character.

The analysis begins by looking at the results of observations of hard work characters (points 3 and 4) of each subject class. From Figure 1 and Figure 2, it can be seen if when completing non-routine mathematics problems, the high-class and middle-class subjects show an indicator of a hard work character value. But low-class subjects (see figure 3) does not show an indicator of hard work character's value. So the analysis is continued by looking at the worksheets of each subject which will begin with an analysis of the high-class subject test sheet in Figure 4 and the middle-class subject test sheet currently in Figure 5.

Eliminasi (i) dan (ii)

$$\begin{aligned} d + e &= 29 \\ f - d &= 7 \\ \hline d + e &= 26 \end{aligned}$$

$$\begin{aligned} d &= 13 \\ d + e &= 29 \\ 13 + e &= 29 \\ e &= 29 - 13 \\ e &= 16 \end{aligned}$$

Substitusi  $d = 13$  ke pers (iii)

$$\begin{aligned} d + e &= 26 \\ 13 + e &= 26 \\ e &= 26 - 13 \\ e &= 13 \end{aligned}$$

Substitusi  $e = 16$

$$\begin{aligned} e + f &= 11 \\ 16 + f &= 11 \\ f &= 11 - 16 \\ f &= -5 \end{aligned}$$

Subject is able to find all the values to fill the empty circle correctly

**Figure 4.** Answer sheet of high-class subjects

The subject is able to complete up to the final step but the answers obtained are incorrect

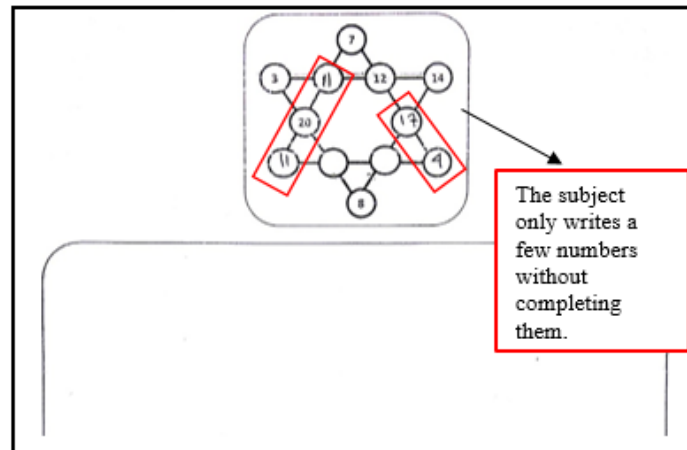
$$\begin{aligned} 3 + 11 + 12 + 14 &= 40 \\ 7 + 11 + 20 + 2 &= 40 \\ 7 + 12 + 10 + 11 &= 40 \\ 2 + 9 + 8 + 11 &= 40 \\ 8 + 9 + 20 + 3 &= 40 \\ 8 + 8 + 10 + 14 &= 40 \end{aligned}$$

Jadi dalam satu garis memiliki jumlah yang sama yaitu 40.

**Figure 5.** Answer sheet of middle-class subjects

From Figure 4 and Figure 5 above, it can be seen if the subject of high-class and middle-class is able to solve all the problems given until the last step so that it is assumed that when solving non-routine problems, high-class and middle-class subjects are showing character values of hard work. This assumption is supported by the results of the interview. When interviewing the subject was asked what he would do if the teacher could not help him to solve the problem, the subject replied *"no problem, I will still try to solve it"*. The same thing was conveyed by the middle-class subject who stated, *"at least done first as much as I can, although maybe the answer is not necessarily correct, at least I have tried doing it"*. The results of the interview further strengthened the initial assumption that when solving non-routine mathematics problems high-class and middle-class subjects showed the character values of hard

work, but different results were shown by low-class subjects. Figure 6 below will show the results of analysis of low-class subject test sheets.



**Figure 6.** Answer sheet of low-class subjects

From Figure 6 above, it can be seen if the low-class subject does not resolve the problem until it is finished, so it is assumed that when solving problems given the subject does not bring up the hard work character value. The assumption is further strengthened by the results of interviews with low-class subjects when the researcher asked whether they still want to solve the problems given, the subject replied "*No, I don't understand*". Subjects stated that even if given additional processing time the subject still did not want to solve the problem because they did not understand what steps should be taken to solve the problem and that is the reason the subject did not bring up hard working indicators when solving the problems given. Based on the results of the analysis above, it can be said that the value of hard work characters only appears in high-class and middle-class subjects but does not appear in low-class subjects when resolving the problems given.

### 3.3. Creativity Character.

Based on Figure 1, Figure 2, and Figure 3 above, it can be seen that when solving the given problem, all subject classes have not shown creative character value indicators so the analysis is continued by looking at the subject test results sheet. The results of the test sheet analysis also showed the same results, it can be seen in Figure 4, Figure 5, and Figure 6 seen if the subjects of high-class, middle-class, and low-class have not shown the indicators of creative character values, so the analysis continued by looking at the results of subject interviews. When the interview the researcher asks the subject to provide another alternative answer and the high-class subject not only able to provide an alternative answer but also provide other alternative solutions, "*can use trial and error but it is difficult so I use this method*". The same thing also appears in the middle-class subjects who are able to provide an alternative answer and other solutions, "*can use the SPLTV method, when the test is willing to try using that method but because the time is not too much so I only use this method*". But a different answer reappeared from a low-class subject, when the researcher asked her to find another alternative answer the subject claimed she could not, because the initial answer he got was because she saw a friend's answer. And then when the researcher was asked to provide another alternative answer the subject stated, "*I do not know, maybe just this way*". Based on the results of the analysis above, it can be said that the value of creative characters only appears in high-class and middle-class subjects but does not appear in low-class subjects when resolving the problems given.

### 3.4. Curiosity Character.

Based on Figure 1, Figure 2, and Figure 3 above, it can be seen if when solving the problem given, the subjects of high-class and middle-class have shown the value of character curiosity while the low-class subject has not shown the value of character curiosity. The results of the observation sheet analysis were also supported by the results of interviews, when the researcher asked what the subjects did when they found difficulties when resolving problems, high-class subjects answered "*when the test I tried to work on my own first, if I still unable to find a solution so I ask the teacher*". Similar results were also shown by the middle-class subject who stated "*I asked when solving problem number 2 because it was difficulty problems*". High-class and middle-class subjects also stated that when learning activities take place, but they also tend to use various learning resources such as looking at the guide on the handout, and asking group friends or teachers. Likewise, with low-class subjects, it turns out the subject during the test ask his friend about things he did not understand even the subject also stated, "*use a booklet (handout) and ask also with friends*". Based on the results of the analysis of the observation sheet and the interview above, it can be said if the character value of curiosity arises in the three subject classes when solving non-routine mathematics problems.

Based on the analysis, it is known that while doing non-routine mathematics problems, there are three subjects who show all the character values that are the focus of this research. One subject only shows the character values of hard work, creativity, and curiosity. One other subject only shows the character value of curiosity. The analysis results of student's character values can be seen in Table 1.

**Table 1.** Values character subject

Subj.	Number	Honesty (1)	Hard Work (2)	Creativity (3)	Curiosity (4)
T	1	✓	✓	–	✓
	2	✓	✓	–	✓
	3	✓	✓	✓	✓
W	1	✓	✓	–	✓
	2	✓	✓	–	✓
	3	✓	✓	✓	✓
R	1	✓	✓	–	✓
	2	✓	✓	–	✓
	3	✓	✓	✓	✓
S	1	✓	✓	–	✓
	2	×	✓	–	✓
	3	✓	✓	✓	✓
P	1	×	×	–	✓
	2	×	×	–	✓
	3	×	×	×	✓

Note :

- (1) : Be honest in doing tests/examinations by following the applicable provisions.
- (2) : Work competently and accurately to actively find ideas and be serious in learning.
- (3) : Complete tasks in various ways of solving problems.
- (4) : Showing curiosity about completing tasks by utilizing various learning resources.
- : The problem does not support the emergence of character values
- ✓ : Character values appear
- ×

Based on the results of the analysis it is known that when solving non-routine mathematics problems the subject tends to show the character value of honest, hard work, creative, and curiosity. This result is in accordance with the results of the old research stating that the value of the character not only be applied in the learning process but also in the process of completing a mathematics problem, including on non-routine problems [8]. Based on the results of the analysis also known if the value of the most dominant character appears is the curiosity value. These results are in accordance with literature who said if a non-routine problem requires students to use prior learnings in new ways, builds depth of conceptual understanding, and by engaging in problem-solving tasks, students will acquire ways of thinking, perseverance, curiosity, and confidence with unfamiliar situations [11]. From the above opinion, it is known that solving non-routine problems can increase students' curiosity, it is consistent with the results of the analysis of the subject that shows if the value of curiosity is the most dominant values occur when the subject working on non-routine mathematics problems. While the character values that rarely appear is the value of honesty.

Based on the above analysis we know that during the learning subjects tend to use a variety of learning resources such as using the hand out, discuss with their friends, and ask teacher. From interviews, we know if the reason they use hand-outs and other learning resources is to help them resolve any given problem. From their reasons, it can be assumed if the non-routine problems spur learners to find information that can help them resolve any given problem. That assumption is supported by the theory that the problem-solving in mathematics helps learners to acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations [12]. Problem-solving also requires the student to search for clues and make connections to the various pieces of mathematics and other knowledge which they have learned [13]. Same with problem-solving, non-routine problems are the kind of problems which are most appropriate for developing mathematical problem-solving and reasoning skills, and development of the ability to apply these skills in real-life situations [10]. From all theories above look similar to the results of the analysis and initial assumptions that say if non-routine problems encourage students to use various learning resources to solve the given problem. So it can be said that the cause of the emergence of curiosity values is due to the difficulty level of the problem which is rarely found to make the subject feel curious and motivated to solve the given problem.

Based on the analysis also known if the value of honesty is the rarest value. Based on the interview is known if the reasons appear and not the appearance of honesty is the confidence in their ability to solving the problems given. From the reason of the subject is known if the subject's ability to solve the problems given affect self-confidence, and it is what drives the subject to bring up the value of honesty during the learning. Besides the complexity of the matter of non-routine that can be said is rare also became one of the reasons students cheating. The above assumption is supported by the theory that good confidence will make them trust himself, while low confidence will lead to feelings of uncertainty, insecurity, fear, and social distance [14]. The concept of self-confidence is not much different from the self-esteem that emphasizes her abilities [15]. If someone with very good self-esteem is more confident not to cheat while someone with low self-esteem is related to dishonesty [16]. From the results of other research in known if the reason most learners to cheat during exams is that students do not prepare well for exams and the difficulty of test questions [17]. As it is known if the type of problem that used in this test is a non-routine problem, and non-routine problems are rarely presented in the daily lessons in the classroom. The non-routine problem requires students to objectively evaluate their capabilities in high-level thinking [18]. That is to say, if the problems presented are problems that still feels unfamiliar to students and requires deep thought, while the difficulty of the problem during a test triggering subject to cheat [17]. From all the opinion above, it can be said if the reason for the value of honesty being rarest value is insecurity subject affected by the low of their ability to resolve problems that are given and the difficulty of the problems given.

#### 4. Conclusion

Based on the analysis and discussion it is known that when working on non-routine mathematics questions, students bring up values of character honesty, hard work, creativity, and curiosity. When



solving non-routine problems, subjects tend to show honesty values that are characterized by solving problems using their own abilities without copying the work of a friend. Subjects also tend to show the value of hard work because students solve each problem until the final step even though the results are incorrect. Subjects also tend to show creative values characterized by solving problems in various ways or being able to provide alternative answers. Subjects also tends to show the value of curiosity when solving non-routine problems that are characterized by using various learning resources such as asking friends or teachers, looking for information on hand-outs or various other learning sources. Based on the results of this study, it is recommended to teachers provide non-routine questions to students because non-routine problems can trigger the emergence of various character values such as honesty, hard work, creative, and especially curiosity value. Teachers are also recommended to pay more attention to the character values of students during learning and can explore other learning media that might also trigger the emergence of student character values. So that, the results obtained from learning are not only focused on assessment but also on student character values.

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