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## **PROFILE OF SENIOR HIGH SCHOOL STUDENTS' MATHEMATICAL REASONING ABILITY BASED ON GUARDIAN PERSONALITY TYPE**


*Research Article*

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## PROFILE OF SENIOR HIGH SCHOOL STUDENTS' MATHEMATICAL REASONING ABILITY BASED ON GUARDIAN PERSONALITY TYPE

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### Abstract

This study targets to 1) describe students' mathematical reasoning skills in terms of guardian personality type; 2) knowing the causes of student mistakes in answering questions. This type of study is descriptive qualitative. The subjects in this study were students of class XI MIPA four Wanasaba 1 Senior High School in East Lombok in the 2020/2021 school year. The determination of the subject was done by purposive sampling and snowball. Data collection techniques used personality tests, tests of mathematical reasoning abilities, and interviews. The validation of each instrument was carried out by three experts in each field. The data analysis stage in this study was data reduction, data presentation, and conclusion. The results of this study indicate that the subject's mathematical reasoning ability only fulfills indicator 4, namely performing calculations based on certain rules or formulas. Subjects have not been able to meet other indicators. This is because the subject considers that the listed formula can be used in all types of triangles, does not know the rules of the cosine rule, the subject rarely practices and answers story questions, difficulties in linking the results obtained with questions, difficulty in choosing the formula to be used, and not careful in doing calculations.

*Keywords:* Profile, Mathematical reasoning, Guardian personality type

### 1. Introduction

Studying mathematics is very important because it will equip someone to think, argue, provide support in the development of science and technology, and can solve problems in everyday life. Mathematics and reasoning are two matters that can't be separated. Mathematics is understood via reasoning and reasoning is trained via studying mathematics (Mariyam & Wahyuni, 2016). Mathematical reasoning ability is a person's ability to sort out what is important and what is not important from a problem (Hidayat & Sariningsih, 2020). The reasoning is logical thinking using inductive and deductive techniques to obtain conclusions (Sari & Darhim, 2020).

Minister of National Education Regulation No. 22 of 2006 (Depdiknas, 2006) states that the purpose of learning mathematics is that students must be able to use reasoning on patterns and traits, perform mathematical manipulation in making generalizations. Besides, the National Council of Teachers of Mathematics (200) states that mathematics learning must be oriented to five standards of the learning process, namely problem solving, communication, connection, reasoning, and representation (NCTM, 2000). Therefore, students' reasoning skills are important to develop.

But the reality is that when viewed from the TIMSS results, Indonesian students are in 44th place with an average of 397 from the 49 countries surveyed. Indonesia's average score is far below the highest average score of 618 achieved by Singapore (TIMSS, 2015). From the TIMSS results, it was published that Indonesian students were nonetheless weak in solving non-routine problems related to proof, solving troubles that required mathematical reasoning, discovering generalizations or conjectures, and finding relationships between the information or facts provided (Nahdi, 2015).

Consciously or unconsciously, every individual behaves, acts, acts, speaks, and thinks differently which psychologists call personality (Arini & Rosyidi, 2016). Personality is a dynamic organization of the individual psychophysical system that determines the thoughts, attitudes, and behavior of individuals in a typical manner (Sarjana & Khayati, 2016). David Keirse, a professor in psychology from California State University, classifies personality into four types, one of which is the guardian personality type. This classification is based on how a person gets his energy (extrovert or introvert), how a person gets information (sensing or intuitive) and how someone makes decisions (thinking or feeling) and how someone observes and judges (judging or perceiving) (Hasanah, Wahyu, & Putra, 2017). Students with the guardian type like classes with traditional models and regular procedures. Students with this type like teachers who clearly explain the material and give instructions in a precise and real way, the material must be started in real life (Putra, 2017).

Several studies on mathematical reasoning have been carried out, consisting of (Widiyasari & Nurlaelah, 2019); (Rokhima, Kusmayadi, & Fitriana, 2019); (Fisher, Kusumah, & Dahlan, 2019); (Wahyuni, Susanto, & Hadi, 2019); (Karunika, Kusmayadi, & Fitriana, 2019); (Sukirwan, Darhim, & Herman, 2018). The studies conducted so far are only general reasoning skills without looking at the other side of the students. Although some researchers examine mathematical reasoning abilities in terms of students' other perspectives such as learning styles and gender, not many have used the results in terms of student personality types. Whereas personality type reflects someone is behaving, acting, acting, speaking, and thinking differently which psychologists call personality (Arini & Rosyidi, 2016). As for some researchers who examined mathematical reasoning abilities with a review of personality types, including (Arini & Rosyidi, 2016); (Widiyatmoko, 2018). The research conducted by Arini and Rosyidi used extrovert and introvert personality type reviews, while the research conducted by Widiyatmoko used artisan, guardian, and rational personality types with the research subjects of junior high school students. Based on the above background, the researcher researched the profile of high school students' mathematical reasoning abilities viewed guardian personality types.

## 2. Methodology

The type of this study is descriptive qualitative. This study targets to 1) describe students' mathematical reasoning competencies in terms of guardian personality; 2) knowing the motives of pupil errors in answering questions. This research was once performed in class XI MIPA four Wanasaba 1 Senior High School in East Lombok in the 2020/2021 school year.

The subjects of this study were three students. The determination of the subject was done by purposive sampling and snowball. The research subjects are presented in Table 1.

Tabel 1. *Subject of Research*

No	initial of the subject	Code
1	RH	S1G
2	FA	S2G
3	RI	S3G

Data collection using tests and interviews. The test consists of a personality test and a test of mathematical reasoning abilities. Personality tests are used to decide students 'guardian personality types and tests of mathematical reasoning skills are used to decide students' mathematical reasoning skills. The type of interview used is a semistructured interview. The data credibility is done by triangulating the time. The data analysis stage used in this study was data reduction, data presentation, and conclusion.

### 3. Result and Discussion

#### 3.1. Subject's Mathematical Reasoning Ability 1 (S1G)

##### 3.1.1. Item Number 1 Make Logical Conclusions

Item number one is an indicator of making logical conclusions. Therefore, what is seen from the S1G answer is a conclusion made accompanied by logical reasons. In this case, it is to conclude which answer is more correct between Fikri's answer and Ahmad in determining the side length of the unknown triangle accompanied by logical reasons. The results of the S1G work are shown in Figure 1 below.

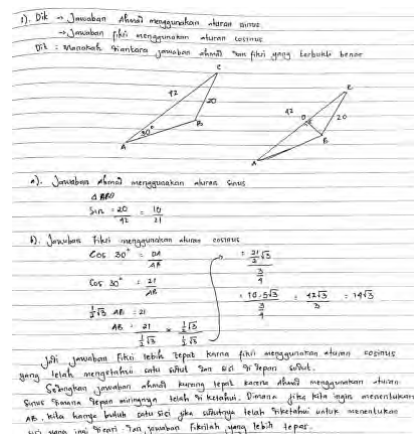


Figure 1. The results of S1G indicators make logical conclusions

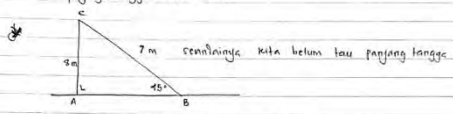
Based on the results of the work, S1G made the triangle into two parts to become a right triangle. S1G can make conclusions correctly, but the arguments or reasons used are not correct. The calculations performed by S1G are incorrect because the lengths of AD and BC are incorrect.

To explore more deeply related to the conclusions and arguments made, the researchers conducted interviews with S1G. The results of interviews with S1G researchers revealed that S1G was unsure and confused about the arguments made in making conclusions. S1G is not sure and confused due to the calculation result obtained by the decimal and not knowing the formula of the cosine rule for any triangle.

##### 3.1.2. Item Number 2 Estimating Answers and Solution Processes

Item number two is an indicator of estimating the answer and the solution process, for that the result of the S1G work seen is how the S1G makes an estimated answer indicated by the calculation results and provides solutions in solving problems. In this case, it is estimated that the ladder is sufficient or not to use to fix the lamp that is on the wall, otherwise what is the solution. The results of the S1G work are shown in Figure 2 below.

2) Dik: tinggi gedung 8 m  
 panjang tangga adalah 7 m



Sementara kita belum tau panjang tangga

Sementara kita belum tau panjang tangga

$$\cos C = \frac{AC}{AB}$$

$$\sqrt{2} = \frac{CB}{8}$$

$$1,414 = \frac{CB}{8}$$

$$CB = 11,312$$

Figure 2. The results of S1G indicators Estimating Answers and Solution Processes

Based on the results of the work, S1G can perform calculations to arrive at the stage of knowing whether the ladder length is sufficient or not, but S1G is only able to reach the count without providing information that whether the ladder is sufficient or not to repair the lamp on the wall.

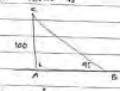
To explore more deeply related to the results of the S1G work which only reached the calculation stage and to find out the cause, the researcher conducted an interview with S1G. The results of interviews with S1G researchers revealed that S1G only arrived at the calculation stage to find the length of the stairs because S1G was confused about whether the length was sufficient or not. In addition, S1G has difficulty linking the results obtained with the questions from the questions.

### 3.1.3. Item Number 3 Doing proof

Item number three is an indicator of doing a proof. Therefore, the result of the S1G work seen is the process carried out in proving, in this case proving that the boat approached the lighthouse when the clinometer showed  $60^\circ$ . The results of the S1G work are shown in Figure 3 below.

3) Dik: tinggi mercusuar = 100 m  
 pada klinometer menunjukkan  $45^\circ$  dan pada saat perahu tersebut  
 ketinggian klinometer berubah menjadi  $60^\circ$   
 Dit: apakah mercusuar akan terlihat oleh perahu saat klinometer berubah  $60^\circ$

sudut  $45^\circ$



Colom  $AB^2 = AC^2 + BC^2$

$$1 = \frac{AB}{100}$$

$$AB = 100 \text{ m}$$

sudut  $60^\circ$

Colom  $60^\circ = \frac{AC}{AB}$

$$\frac{1}{2}\sqrt{3} = \frac{AB}{100}$$

$$AB = \frac{100}{\frac{1}{2}\sqrt{3}}$$

$$AB = \frac{200}{\sqrt{3}}$$

$$= \frac{200\sqrt{3}}{3}$$

$$= 100\sqrt{3}$$

Jadi ketika klinometer menunjukkan sudut  $60^\circ$ , perahu akan terlihat oleh mercusuar

Figure 3. The results of S1G indicators Doing Proof

Based on the results of the work, S1G is able to prove with the right steps and formulas, but the result of one of the calculations is wrong and causes the final result to be wrong.

To explore more deeply related to the evidentiary process carried out and the causes of the mistakes made by S1G, an interview was conducted. The results of interviews with S1G researchers revealed that S1G was able to explain the evidentiary process carried out and S1G admitted their mistakes in doing calculations. S1G is wrong in doing calculations because the S1G is not accurate.

### 3.1.4 Item Number 4 Perform calculations based on certain rules or formulas

Item number four is an indicator of performing calculations based on certain rules or formulas. In this indicator, the results of the S1G work seen are the rules or formulas used in the problem-solving process. The results of S1G work are presented in Figure 4 below.

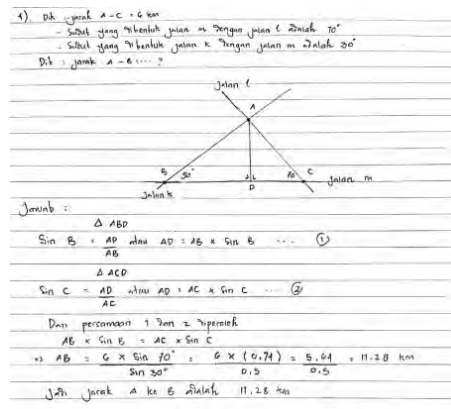


Figure 4. The results of S1G indicators Perform calculations based on certain rules or formulas

Based on the results of the work, S1G was able to solve question number four correctly and with the correct formula and calculations.

To explore more deeply related to the results of S1G work, the researchers conducted interviews with S1G. The results of interviews with S1G researchers revealed that S1G was able to explain the results of their work correctly and without feeling the slightest difficulty.

## 3.2. Subject's Mathematical Reasoning Ability 2 (S2G)

### 3.2.1. Item Number 1 Make Logical Conclusions

Item number one is an indicator of making logical conclusions. Therefore, what is seen from S2G's answer is a conclusion made with logical reasons. In this case, it is to conclude which answer is more correct between Fikri's answer and Ahmad in determining the side length of the unknown triangle accompanied by logical reasons. The results of S2G work are presented in Figure 5 below.

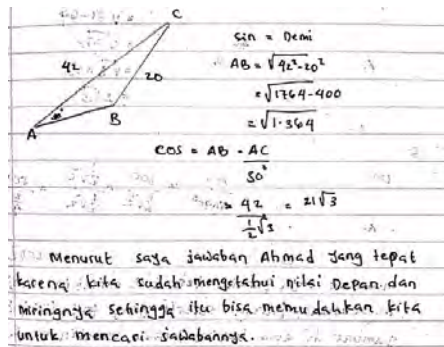


Figure 5. The results of S2G indicators make logical conclusions

Based on the results of the work, S2G has not been able to make correct conclusions and the formula arguments used are still wrong.

To explore more deeply related to the conclusions made and the causes of the misuse of the formula used by S2G, the researchers conducted an interview with S2G. The results of the researcher interview with S2G revealed that S2G was able to explain the reasons for the conclusion that Ahmad's answer was the more correct one, but the formula he wrote was wrong. S2G is wrong in using the formula to find the length of AB because S2G thinks that the formula is written can be used in all triangles.

### 3.2.2. Item Number 2 Estimating Answers and Solution Processes

Item number two is an indicator of estimating the answer and the solution process. Therefore, the result of S2G's work that is seen is how S2G makes approximate answers that are indicated by the calculation results and provide solutions in solving problems. In this case, it is estimated that the ladder is sufficient or not for use in fixing the lamp on the wall, otherwise what is the solution. The results of S2G work are presented in Figure 6 below.

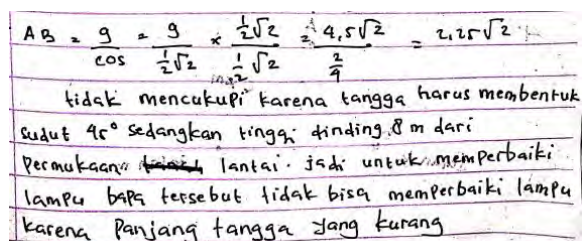


Figure 6. The results of S2G indicators Estimating Answers and Solution Processes

Based on the outcomes of the S2G work, the results of the calculations with the conclusions made are not in harmony, besides that the purpose of the conclusions to be conveyed is still unclear.

To explore more deeply related to the results of the S2G work, an interview was conducted. The results of the interview with S2G researchers revealed that S2G was confused in answering this question so that S2G answered carelessly because they rarely answered story questions.

### 3.2.3. Item Number 3 Doing proof

Item number three is an indicator of verification. Therefore, what is viewed from the outcomes of the work is the proving process carried out by S2G, in this case proving that the boat approached the lighthouse when the clinometer showed  $60^\circ$ . The results of S2G work are presented in Figure 7 below.

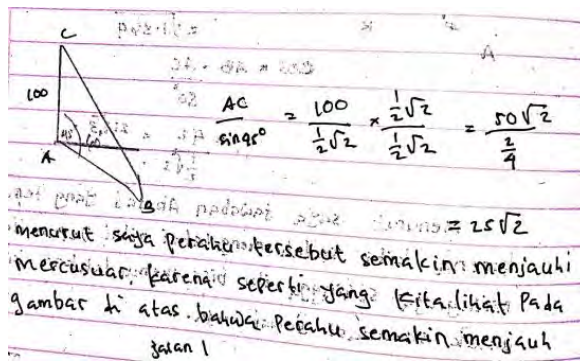


Figure 7. The results of S2G indicators Doing Proof

Based on the results of the work, S2G made a mistake in illustrating a triangle image, so that the proof was wrong and the calculations made did not have a clear purpose.

To explore more deeply related to the evidentiary process carried out and to find out the cause of the wrong S2G in using the formula, the researchers interviewed with S2G. The results of interviews with S2G researchers revealed that S2G was wrong in making triangular illustrations because S2G had difficulties in translating questions and rarely practiced answering questions in the form of stories.

### 3.2.4. Item Number 4 Perform calculations based on certain rules or formulas

Item number four is an indicator of performing calculations based on certain rules or formulas. In this indicator, the results of the S2G work that will be seen are the rules or formulas used in the problem-solving process. In this case, it is to determine the length AB of any triangle. The results of S2G work are presented in Figure 8 below.

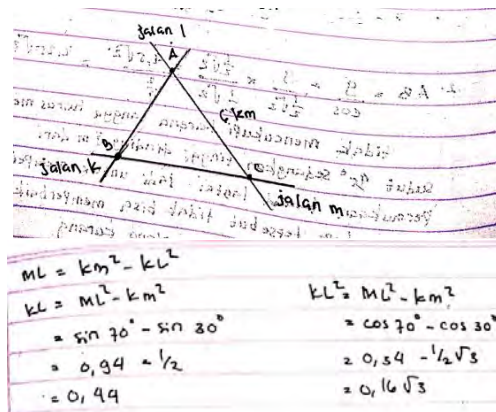


Figure 8. The results of S2G indicators Perform calculations based on certain rules or formulas

Based on the results of the work, S2G was wrong in using the formula to determine the length of AB, so that the results obtained were also wrong.

To explore more deeply related to the formula used and to find out why S2G was wrong in using the formula, an interview was conducted. The results of interviews with S2G researchers revealed that S2G in using the formula was based on pyretic. besides, S2G didn't know the formula for the sine and cosine rules. S2G doesn't know the formula for the sine and cosine rules because S2G doesn't really understand the material for the sine and cosine rules.



### 3.3. Subject's Mathematical Reasoning Ability 3 (S3G)

#### 3.3.1. Item Number 1 Make Logical Conclusions

Item number one is an indicator of making logical conclusions. Therefore, what is seen from S3G's answer is a conclusion made with logical reasons. In this case, which answer is more correct between Fikri's answer and Ahmad in determining the side length of the unknown triangle accompanied by logical reasons. The results of S3G work can be seen in Figure 9 below.

11 Jawaban antara Ahmad dan Fikri yang benar adalah Fikri.  
 ⇒ Jawaban Fikri benar karena untuk aturan cosinus kita hanya membutuhkan satu sudut dan dua sisi pada segi tiga seperti salah satu rumus dari aturan cosinus yang merupakan gambar tersebut yaitu

$$c^2 = a^2 + b^2 - 2a \cdot b \cdot \cos C$$

Figure 9. The results of S3G indicators make logical conclusions

Based on the results of the work, S3G was able to make conclusions and with the correct arguments in the form of writing the formula from the cosine rule.

To explore more deeply the conclusions and arguments made by S3G, the researchers conducted interviews with S3G. The results of the researcher interview with S3G revealed that S3G was able to explain the conclusions made along with the correct arguments.

#### 3.3.2. Item Number 2 Estimating Answers and Solution Processes

Point number two is an indicator of estimating the answer and solution process, for that the result of S3G work that is seen is how S3G makes an estimated answer that is indicated by the calculation results and provides solutions in solving problems. In this case, it is estimated that the ladder is sufficient or not used to fix the lamp on the wall, otherwise what is the solution. The results of S3G work can be seen in Figure 10 below.

12 Tangga tersebut harus memiliki panjang 10 m untuk bisa memperbaiki lampu yang terdapat pada dinding rumah. Karena jika panjang tangga 9 m maka ayah tidak bisa memperbaiki lampu yang ada pada dinding rumah

Figure 10. The results of S3G indicators Estimating Answers and Solution Processes

Based on the results of the work, S3G was unable to predict answers or provide solutions accurately. S3G immediately explained that the length of the ladder must be 10 m if you want to repair the lamp without going through the calculation phase first.

To explore more deeply related to the results of the S3G work, an interview was conducted. The results of interviews with S3G researchers revealed that S3G found it difficult to determine the formula to be used in the completion process.

#### 3.3.3. Item Number 3 Doing proof

Item number three is an indicator of verification. Therefore, what is viewed from the outcomes of the work is the proving process carried out by S2G, in this case proving

that the boat approached the lighthouse when the clinometer showed  $60^\circ$ . The results of S3G work can be seen in Figure 11 below.

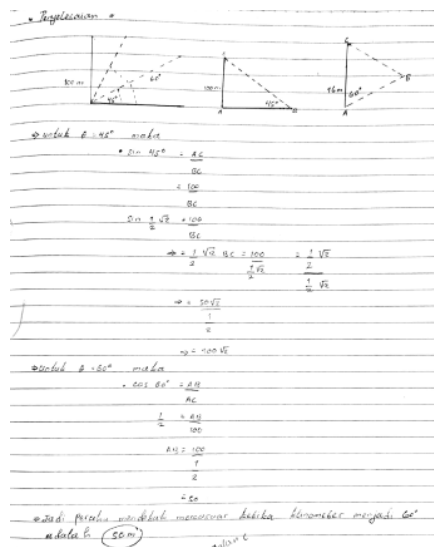


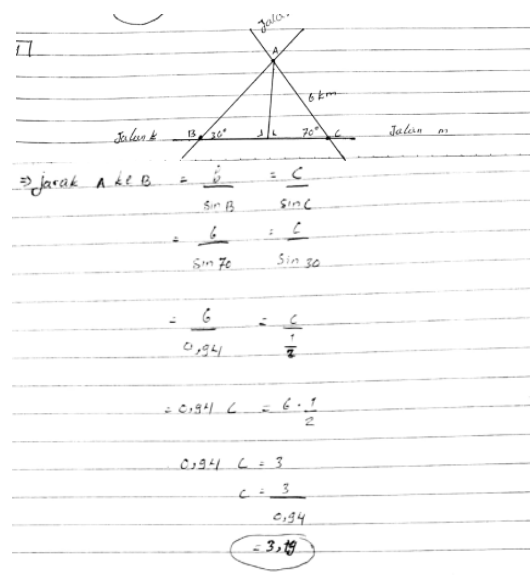
Figure 11. The results of S3G indicators Doing Proof

Based on the results of the work, S3G has not been able to prove it properly. The steps used in proving are correct but the formula used is not correct so the calculation results are wrong.

To explore more deeply related to the proof process carried out by S3G and to find out why S3G was wrong in using the formula, the researchers interviewed S3G. The results of the researcher interview with S3G revealed that S3G thought that the distance to be sought was the slanted side of the image created. S3G incorrectly uses the formula due to misinterpreting the questions from the questions.

#### 3.5.4. Item Number 4 Perform calculations based on certain rules or formulas

Item number four is an indicator of performing calculations based on certain rules or formulas. In this indicator, the results of S3G work that are seen are the rules or formulas used in the problem-solving process. In this case, it is to determine the length AB of any triangle. The results of S3G work are presented in Figure 12 below.



*Figure 12.* The results of S3G indicators Perform calculations based on certain rules or formulas

Based on the results of the work, S3G used the formula correctly but was wrong in determining the value of  $\sin B$  so that the results obtained were wrong.

To explore more deeply the formula used and the causes of the S3G error in making calculations, the researchers interviewed with S3G. The results of interviews with S3G researchers revealed that S3G was able to explain the formula used but there were errors in the calculation process. S3G made mistakes in counting due to not being careful in answering the questions so that there were errors and caused the final result to be less precise.

### **3 Conclusions**

Based on the results above, it is found that the guardian type subject is only able to meet the indicator to perform calculations based on certain rules or formulas. While other indicators do not fulfill, namely: 1) The indicator makes logical conclusions only subject 3 fulfills it while other subjects do not. Therefore, the final result is that the subject does not meet this indicator. The subject does not meet the indicators to make logical conclusions because the subject misstates the formula as an argument. The error in listing the formula is caused because the subject thinks that the formula listed can be used in all types of triangles, other than not knowing the formula of the cosine rule; 2) In the indicator of estimating the answer and solution process, there are no subjects who meet so that the final result is that the subject does not meet this indicator. Most of the subjects on this indicator did not arrive at the final answer and did not look for what they should be looking for and mistakenly interpreted the questions from the questions. This is because the subject rarely practices and answers story questions, difficulties in linking the results obtained with question questions, and difficulty in choosing the formula to be used; 3) The indicator proves that only subject 1 fulfills, while other subjects do not. Therefore, the final result is that the subject does not meet this indicator. The subject does not meet the indicators to prove it because the subject is wrong in using the formula, makes the wrong illustration of the picture, and wrong in doing the calculation. This is because they rarely practice answering story questions and are not careful in calculating.

### **4 Conflict of Interest**

The author declare that there is no conflict of interest.

### **5 Ethics Committee Approval**

The authors confirm that the study does not need ethics committee approval according to the research integrity rules in their country..

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