Research Article

The RRSI (Right Region for Shading Inequalities)

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Abstract: *Mathematics is often perceived as a difficult subject, which may discourage some people from learning it. Calculus is a branch of Mathematics that requires prior knowledge of pre-calculus. One topic in pre-calculus is solving a system of inequalities by graphing. The key to solve such problem is by ensuring that the shaded region is correct and follows the inequalities sign. During examinations, students are required to shade the correct region based on a few basic functions such as linear, constant, parabola, and circle. Each function has different inequality signs, which means that students need to shade different regions accordingly. Therefore, this innovation aims to help students to determine the correct region to be shaded more easily. By improving their understanding, this may increase their interest in Mathematics.*

Keywords: System of inequalities; graph; shaded region.

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1. INTRODUCTION

Mathematics is often perceived as a difficult subject, which may discourage some people from learning it. International surveys that have been conducted indicate that Mathematics is a hard subject to learn (Ayebo & Mrutu, 2019). Although difficult, Mathematics is an essential knowledge for everyone. Previous researchers conclude that Mathematics is important in daily life (Daud et al., 2020; Hagan et al., 2020). Most of the students were found to be aware of the value of mathematics (Kunwar, 2021). Since we were in kindergarten, we have been taught fundamental mathematical operations such as addition, subtraction, multiplication, and division of real numbers. We use Mathematics in our daily life even to count our height, age, counting money and more. In addition to its fundamental applications, Mathematics is also used at more challenging levels in fields such as engineering and medicine, which we can be learnt at a higher level of education. In engineering courses for example, the understanding of mathematical principles is necessary (Giannoulas & Stampoltzis, 2021). Engineering students must be able to study and practise mathematical concepts and techniques in class and subsequently in their careers (Giannoulas & Stampoltzis, 2021).

Many researchers had done research to investigate the student's perception towards Mathematics. Interestingly, studies revealed that some students had a positive perception and vice versa. Students' perceptions are influenced by several elements, including many psychological and cognitive factors connected to anxiety, motivation, and learning methods, which are found to significantly influence students' attitudes and perceptions towards Mathematics (Ayebo & Mrutu,

2019). Furthermore, mathematical anxiety also rises due to low self-esteem and fear of failure towards the subject which influences the learning of Mathematics and the academic achievement (Singh et al., 2020). A study discovered that students believed that they were being taught by lecturers who are knowledgeable and skilled in the discipline, which is another significant element that influences how people perceive mathematical subjects (Setapa et al., 2016).

According to several researchers, students' perception towards Mathematics does not affect how well they achieve. Although they consider Mathematics to be challenging, the students have a good perception of it because they use and know the importance of Mathematics (Hagan et al., 2020). The relationship between perception and students' performance in Mathematics showed that it is weak and is negatively related (Hagan et al., 2020). Another study also agrees with a similar outcome where the results show no significant difference between students' perception towards Mathematics and recent Mathematics grades (Daud et al., 2020). Nevertheless, there are some studies that have found that students' perception towards Mathematics influences their performance. The sense of accomplishment and competence that students develop, heavily depends on their perception of Mathematics and their comprehension of it (Singh et al., 2020). Therefore, enhancing positive perception towards Mathematics can help improve the performance in Mathematics (Wasike et al., 2013). The group of students who performed better in Mathematics were found to be more optimistic and confident, while the weaker students were found to be pessimistic and nervous (Kunwar, 2021).

In Mathematics, one of the main branches is calculus. Students must learn pre-calculus first and one of the topics is solving a system of inequalities by graphing. The most important step in solving a system of inequalities is to ensure the region that we shade is correct following the inequalities sign. But during examinations, students need to memorize the region based on a few basic functions such as linear, constant, parabola and circle. Different functions, with different inequalities sign means that the students need to shade different regions. If the students cannot memorize and determine the correct shaded region, this may result in stress and less interest to learn this topic. Therefore, this innovation will help the students to understand and remember the correct region to be shaded easily. If the students can understand easily, this can improve their interest in Mathematics and reduce their negative perception on this topic.

2. METHOD & MATERIAL

In this paper, we will try to summarize the few basic functions such as linear, constant, parabola, and circle into one simple figure that students can easily remember.

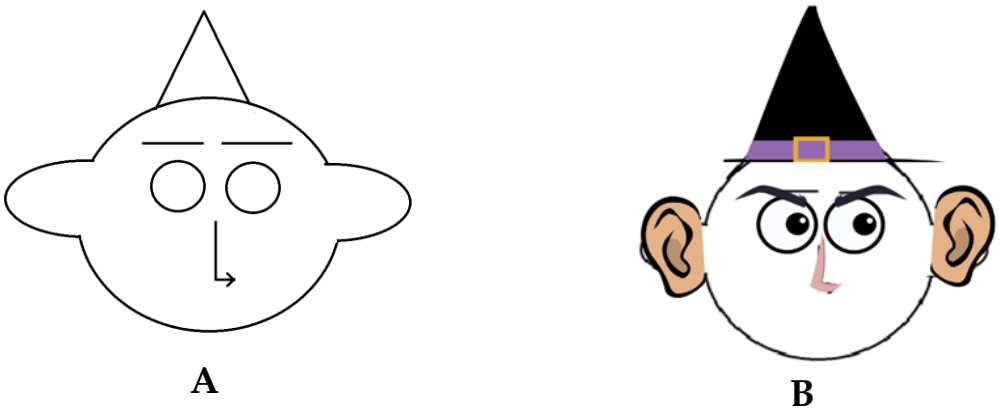
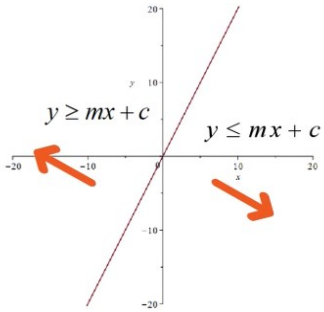
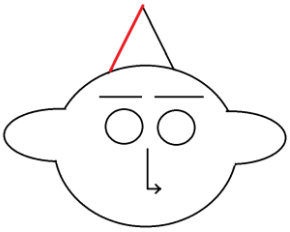
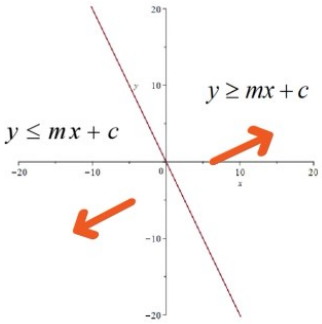
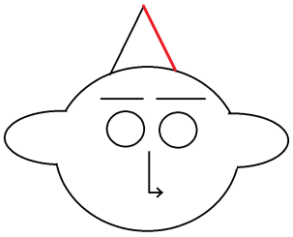
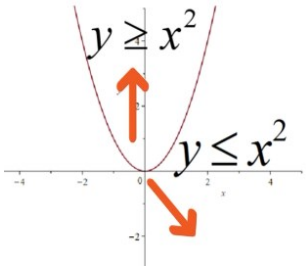
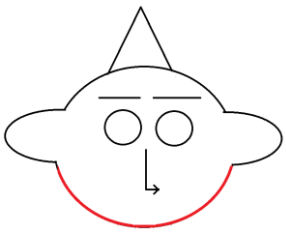


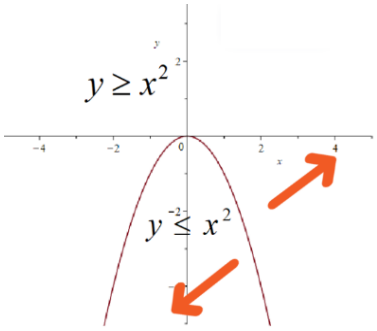
Figure 1. RRSI figure.

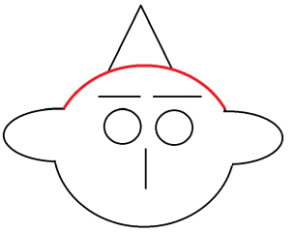
As seen in Figure 1, a simple figure that resembles a person's face has been created. This figure is called the RRSI which stands for Right Region for Shading Inequalities. In Figure 1, students must remember Figure A, where Figure A can be imagined as a person's face as in Figure B. This person's face includes eyes, nose, ears, eyebrows, and a hat. Then, how can this figure help students to solve the system of inequalities? Table 1 will clearly explain how the RRSI figure can represent the basic functions such as linear, constant, parabola and circle. Note that for the inequalities sign $\geq$ *and* $\leq$, the figure should be drawn using a solid line. Whereas for > and <, the RRSI figure should be drawn by using a dashed line.

Table 1. Table for explanation on RRSI component.

Graph of functions	RRSI component	Explanation on RRSI component
Graph of a straight line with positive slope. 		The red line represents the straight line with a positive slope.
Graph of a straight line with negative slope. 		The red line represents the straight line with a negative slope.
Graph of a parabola concave up. 		The red curve represents the parabola concave up.

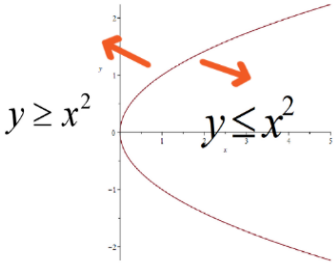
Graph of a parabola concave down.

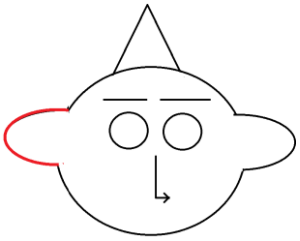




The red curve represents the parabola concave down.

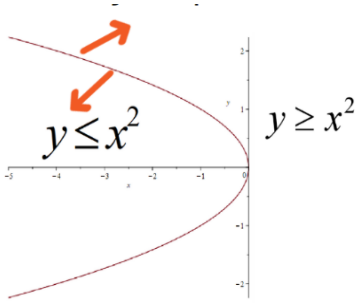
Graph of a concave to the right.

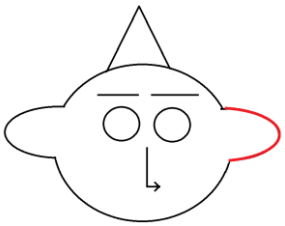




The red curve represents the parabola concave to the right.

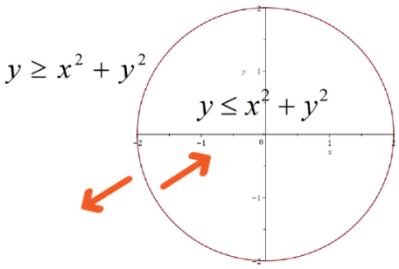
Graph of a parabola concave to the left.

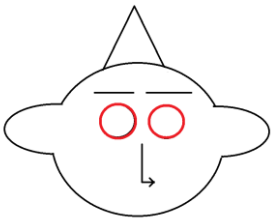




The red curve represents the parabola concave to the left.

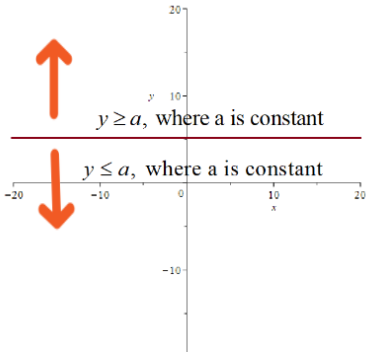
Graph of a circle.

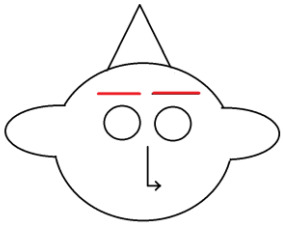




The red circles represent the graph of the circle.

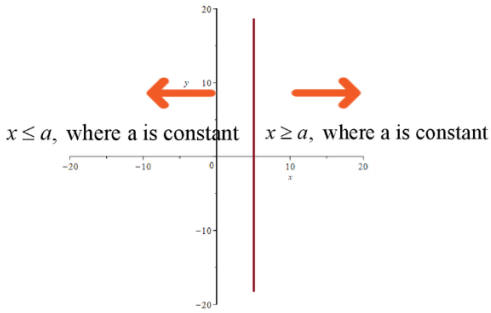
Graph of a constant function $y = a$.

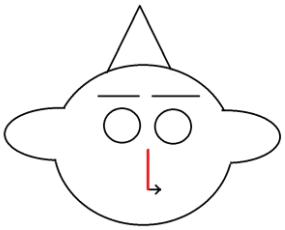




The red lines represent the constant function at $y = a$, where a is constant.

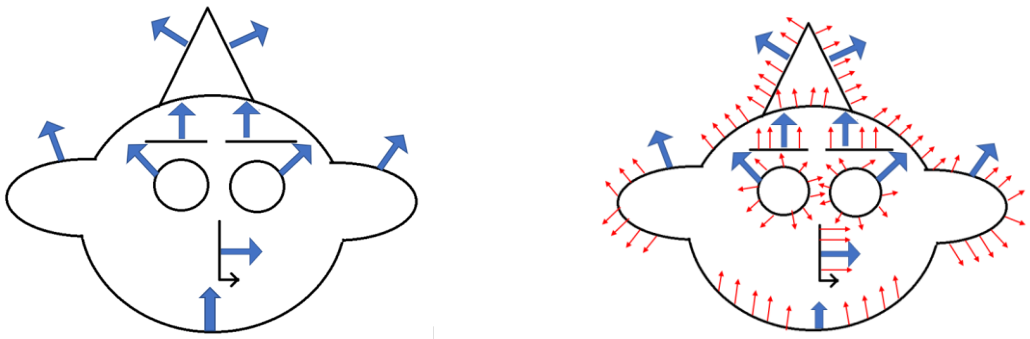
Graph of a constant function $x = a$.





The red line represents the constant function at $x = a$, where a is constant.

Figure 2 shows the RRSI figure with arrows. The arrows represent the direction for the greater than or greater than equal region. Therefore, the opposite direction is for less than or less than equal region. What students need to memorize is just the RRSI figure and the arrows, where the arrow only points in the positive direction (up or right). As an example, let us see Figure 3. It is the parabola concave to the right. The green region where the arrow is pointing outside the curve, means greater than equal region, whereas the yellow region, which is the region inside the curve refers to the less than equal region.



A B

Figure 2. RRSI shaded region.

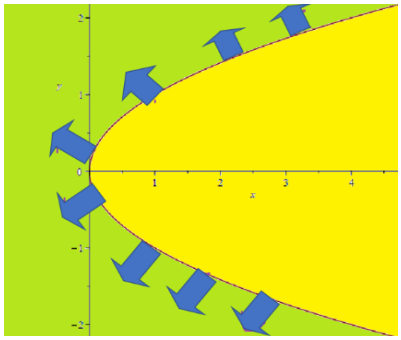


Figure 3. The correct region to be shaded for inequalities graph (parabola concave to the right).

3. FINDINGS

This method believed that students can easily understand where the correct region is and the one that should be shaded when solving a system of inequalities. This is because, we believed that Figure 1, can be remembered more easily and Figure 2, can be easily understood.

3.1 Improve students' understanding.

This RRSI figure is simple to remember or recall. Additionally, it is easy to comprehend because students must understand that the arrows in Figure 2 indicate a positive direction. If they want to shade the greater than or greater than equal region, they will shade in this direction. As a result, they must shade the opposite region if the exam question asks for a region that is less than or equal to. Because of this, students' exam scores will increase if they can comprehend and recall the RRSI figure.

3.2 Improve students' interest towards Mathematics.

One of the most prominent factors that encourage involvement is interest (Eccles, 2016). When students can understand the concept of RRSI figure, students will easily understand this topic, hence this will lead their interest towards the topic system of inequalities more and become more positive towards learning.

3.3 Improve students' performance.

If students are motivated to learn, it indicates that they appreciate Mathematics, which will improve their performance and comprehension of the topic. This is supported by the previous study that indicates that positive perception towards Mathematics can improve the performance of Mathematics (Wasike et al., 2013).

4. CONCLUSION

RRSI figures should be implemented in class during pre-calculus lessons to help the students to understand the correct shaded region for the system of inequalities. It is recommended that for future study, more innovation can be produced to help students to understand Mathematics which is known as a killer subject. Although Mathematics is a quantitative study, we can enhance Mathematics with more colours so that everyone can appreciate its aesthetic qualities. This simple innovation can help to improve students' understanding, students' interest, and students' performance on a part of Mathematics which is a system of inequalities.

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