# Refractive Thinking Ability of High School Students Based on Adversity Quotient in Research-Based Learning Model

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## Abstract

This research is qualitative research. This research aimed to analyze students' refractive thinking skills in terms of their learning independence. The research was conducted at Senior High School 2 Salatiga with 4 students in class XI for the 2022/2023 academic year as subjects. The selection of research subjects was based on the results of high and moderate adversity quotients. The research instruments were a test of refractive thinking and interview guidelines. Based on the results of the analysis, it was found that subjects with high AQ can accomplish all refractive thinking indicators. Moderate AQ subjects have been unable to meet the strategic and evaluation indicators.

**Keywords:** Refractive Thinking, *Research Based Learning*, *Adversity Quotient*

## 1. Introduction

Mathematics is a subject that has been taught since elementary school and can mold students' minds. Through learning mathematics, students will form a way of thinking that is logical, critical, and systematic. Currently, students need higher-level thinking to succeed. Students must be trained with learning models that support higher-level thinking as part of the process of improving their thinking processes (Ministry of Education and Culture, 2018).

Based on observations in the field, students usually only depend on the teacher's explanation so they cannot build their way of thinking. In line with Sopian (2017) states that through teaching, teachers can form a concept of the way of thinking of each student. While in the present day, students need a higher-level way of thinking.

Piaget's cognitive development (Sunarno, 2009) defines the characteristics of a high school student, including the formal operational stage where students have better abstract thinking skills and hypotheses. Meanwhile, there are two dimensions of higher-level thinking, namely reflective thinking and critical thinking, both of which are considered as crucial elements in learning

mathematics and cannot be separated (Erdogan, 2020). Where both are included in the key factors that can facilitate students with professional practice skills (Beavers et al, 2017). According to Downey (Prayitno et al., 2016), refraction is the link between reflective thinking and critical thinking. So, it can be concluded that reflective thinking produces a decision followed by critical thinking. According to Maslukha et al (2018), through reflective thinking and critical thinking, one can formulate a decision-making process, namely reflective thinking.

The purpose of gathering information from questions is to identify the students' attitudes and thoughts to further work on the questions they will be working on in the future (2020). Students' refractive thinking ability can be related to the ability to observe difficulties, also known as the adversity quotient (Stoltz, 2000). The adversity quotient is often identified with the fighting power to fight difficulties (Hidayat, 2018). So, when students have a high adversity quotient, they are able to face and overcome the difficulties they face. But on the contrary, students who have a low adversity quotient think that difficulty is the end of the struggle.

In addition, there needs to be a new classroom atmosphere using learning that facilitates students with professional practice skills. This study uses the Research Based Learning model. This model involves students in identifying questions, and planning steps to find, collect, use, synthesize and evaluate information. According to Suryosubroto (2009: 215), Research-Based Learning is an approach designed to facilitate students in overcoming student skills regarding the breadth and diversity of sources in the form of books, journals, newspapers, multimedia, and so on. This is in line with Hakim's research (2020) which found that RBL can have a significant effect on improving proof skills of the questions that have been given. RBL can also provide new experiences for students because students will be involved in research to find answers to a problem.

According to the description above, the researcher will study high school students' refractive thinking skills in terms of their adversity quotient in the research-based learning model.

## 2. Methodology

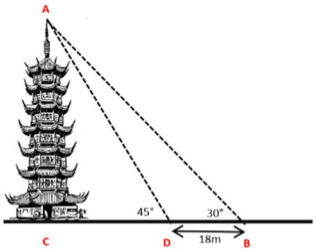
This type of research is qualitative research. The subjects in this study were 4 class XI students of Senior High School 2 Salatiga for the 2022/2023 academic year. The subject collection was conducted with a purposive sampling technique. Subject was selected from two adversity quotient categories, namely high level and medium level. The instruments in this study included adversity quotient questionnaires, tests of refractive thinking skills, and interview guidelines. The data collection technique in this study used the documentation method in the form of photos during field research and recordings of the results of subject interviews, then the questionnaire method in the form of the student's adversity quotient scale, the test method in the form of the results of students' refractive thinking ability tests, and the interview method in the form of interviews with students. Qualitative data analysis techniques in this study were data reduction, data presentation, and drawing conclusions.

## 3. Result and Discussion

This study examined refractive thinking skills of students with high and moderate levels of adversity quotients. The research subjects worked on 4 questions which consisted of indicators of

reflective thinking, namely identified of problem, strategic and evaluation. Refractive thinking ability test questions are shown in Table 3.1.

**Table 3.1. Refractive Thinking Ability Test Questions**

| No | Questions |
|---|---|
| 1 | Rina is a student of class X Sukamaju Senior High School. She got an assignment from his math teacher to measure the height of the flag in hed school yard. Question:<br>a. Write at least 2 alternative steps that can be done by Rina!<br>b. If Rina's height is 155cm, standing in front of the flagpole at a distance of 12m from the front of the pole and the elevation angle indicated by the clinometer is 45°, what is the height of the flagpole? Complete with the sketch! |
| 2 | Dinda stands 8m away from a tower. Then Dinda looked at the top of the tower using the clinometer and got an elevation angle of 30°. If the distance between Dinda and the ground is 145 cm, what is the height of the tower? |
| 3 | Dori, whose height is 120 cm, was asked to measure the height of a building in the city center using a clinometer. In the first position, the clinometer shows an angle of 45°, then he walks 10 meters closer to the building, and the clinometer shows an angle of 60°. Determine the height of the building accompanied by a sketch! |
| 4 | Look at the following picture!<br>  <br>Based on the picture, it is known that at a certain position the elevation angle of the pagoda peak is 30°. Meanwhile, at a distance closer to the base of the pagoda, the elevation angle is 45°. The distance between the elevation angles of 30° and 45° is 18 meters. Determine the height of the pagoda! |

Based on the results of the adversity quotient questionnaire, subjects with high and medium level categories were obtained as shown in Table 3.2.

**Table 3.2. Adversity Quotient Level Grouping**

| Level Adversity Quotient | Total Students | Percentage |
|---|---|---|
| Climber ( Level Tinggi ) | 11 | 32,35% |
| Campers ( Level Sedang ) | 23 | 67,65% |
| Total | 34 | 100% |

Based on Table 3.2, there are 11 students with high AQ levels, namely climbers, and 23 students with moderate AQ levels, namely campers. From the grouping of subject levels based on their categories, 4 were selected where 2 subjects were in the high AQ category and 2 subjects were in the moderate AQ category. High AQ subjects are subjects with KE-09 and KE-25 codes. While moderate AQ subjects are subjects with KE-32 and KE-20 codes.

Based on the interview results and the results of the subject's refractive thinking ability test, the results and discussion will be defined from the three stages of refractive thinking as follows:

At the identified problem stage, the indicators gather information from the problem, interpret the information, and connect it to previous knowledge. Subjects with a high AQ category did not experience significant difficulties, in subjects with moderate AQ, some subjects failed to write down the information they knew. This can be seen from the subject's answers in Figure 3.1.

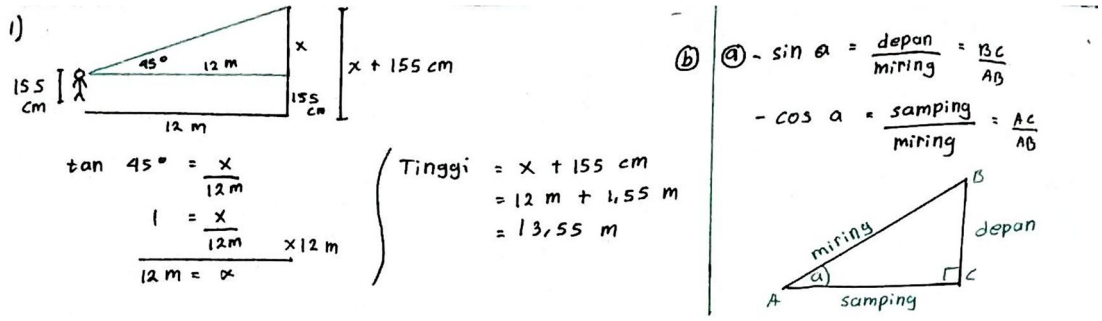



**Figure 3.1 Work Results of KE-20**

At the strategic stage, the indicators were proposing several alternative solutions, eliminating these ideas to obtain the best solution, implementing strategies, conducting checks using formal evidence, and determining the right answer based on the problem at hand. In subjects with a high AQ category, it can be seen that the subject can propose two alternative solutions and choose one of the solutions they think about. The work process looks complete and coherent. This can be seen from the subject's answers in Figure 3.2.

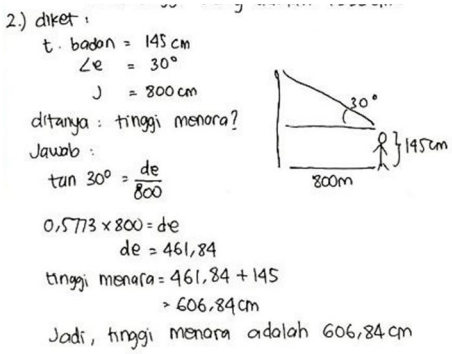



**Figure 3.2 Work Results of KE-25**

Proposing two other alternative solutions can be proven by the results of interviews with Subject KE-25 in Table 3.3.

**Table 3.3. Interview Results with KE-25**

| | | |
|---|---|---|
| P | : | "Do you think there is another way to accomplish this?" |
| KE-25 | : | "Yes Mrs., just like I said earlier in number 1. We can also wear tan, but use the corner of the triangle on top, as well." |
| P | : | "Can you explain it?" |
| KE-25 | : | "Same with number 1, let's find out how big the top corner is first. Then use it to find the question." |
| P | : | "If you use the top corner, how much do you use?" |
| KE-25 | : | "Use 60 tan, then the result will also be added to Dinda's height" |
| P | : | "Okay. But you still use the first method, right?" |
| KE-25 | : | "Yes mom" |

Therefore, in subjects with moderate AQ, the two subjects were only able to propose one alternative solution and use that solution. Based on the results of the interviews, it was shown that the subject believed that there was only one solution that could be used and considered that the solution was correct. This can be seen from the results of interviews with the KE-32 subject in Table 3.4.

**Table 3.4. Interview Results with KE-32**

| | | |
|---|---|---|
| P | : | "Could you please explain how?" |
| KE-32 | : | "In the question, it is known that the elevation angle is tan 45°. So just look for the height with x. After that, because tan 45° equals 1, so 1 multiplied by 1200 equals 1200. Then 1200 is added to 155 and the result is 1355 cm." |
| P | : | "Do you think there is another way to accomplish this?" |
| KE-32 | : | "Maybe there is, Mrs., but I only know to use this method, Mrs." |
| P | : | "Okay, are you sure about your answer?" |
| KE-32 | : | "Already Mrs.." |

In the evaluation stage, the indicator was to re-check whether the answers specified were correct. Subjects with high AQ consistently write down the final conclusions of the answers. When the interview ended, the subject was checked again by the interviewer. But there are still questions that are not re-evaluated which results in errors that arise during the process of working on the questions. This can be seen from the subject's answers in Figure 3.3.

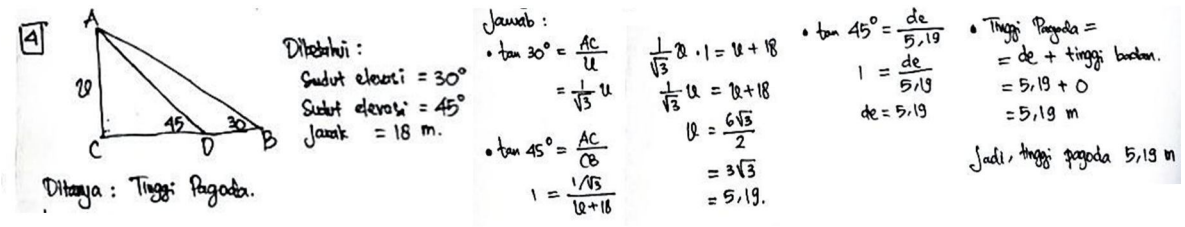



**Figure 3.3 Work Results of KE-09**

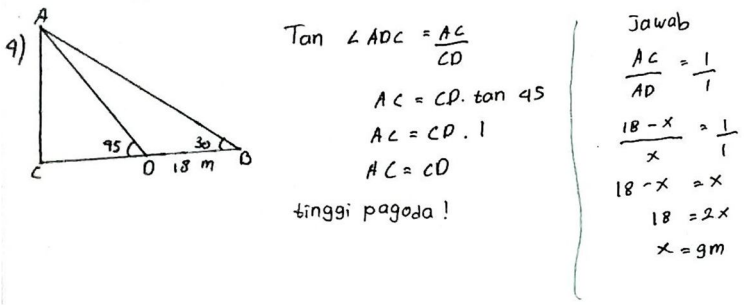
Subject error of KE-09 was explained in the interview excerpt in Table 3.5.

**Table 3.5. Interview Results with KE-09**

| | | |
|---|---|---|
| P | : | "Could you please explain how that works?" |
| KE-09 | : | “Initially looking for AC first from tan 30° and tan 60° then adding height. Because in the question there is no height, I will write 0, Mrs.." |
| P | : | "Are you sure about your answer?" |
| KE-09 | : | "I don’t think so Mrs. because I'm also confused why there isn't a height here." |
| P | : | "Try reading it again. Is there any information that someone is standing?” |
| KE-09 | : | "No Mrs.." |
| P | : | "Well, if there isn't, what does that mean?" |
| KE-09 | : | "Hmm.. That means it's not the same as numbers 1-3, Mrs.." |
| P | : | "Try to pay attention to your answer again. Pay attention to what you write.” |
| KE-09 | : | "This is the tan of 30°, right? For those with a 45° tan, it seems I was the wrong Mrs. in the section looking for the x." |
| P | : | "What's wrong with that?" |
| KE-09 | : | "Here Mrs., I entered the wrong x. I guess I didn't do the math carefully. It seems that if you do the math again, the answer will be different.” |
| P | : | "Okay, then that means it's your fault because you weren't careful with the calculation, right?" |
| KE-09 | : | "Yes Mrs., it seems so." |

Therefore, in subjects with moderate AQ, the subject did not write down the final conclusion of the answer. As a result, errors appeared when attempting to answer the questions since the subject failed to double-check the conclusions. This can be seen from the subject's answers in Figure 3.4.

**Figure 3.4 Work Results of KE-20**




According to the description above, every subject has different achievement indicators depending on the AQ level. In general, subjects with moderate AQ can meet the identified indicators of problems. Meanwhile, the strategic and evaluation indicators have not been met. The results are in line with Hidayat (2019), who asserts that students with moderate AQ are able to solve problems by writing down what is known and what is being asked. Meanwhile, subjects with high AQ can meet all indicators identified of problem, strategic and evaluation. All the results of the analyzes conducted on moderate and high AQ subjects were based on the results of the subject's work and the results of the interviews collected. This is in line with Stoltz (2000) stating that

someone with a high AQ is an individual who can solve problems and will struggle in facing problems by using the maximum solution.

## 4. Conclusion

According to research results, the ability to think reflectively reviewed based on an adversity quotient in a research-based learning model can be described as follows: (1) students with high AQ can meet all indicators of reflective thinking and can propose two alternative solutions, (2) students with AQ being able to meet the identified indicators of the problem and being able to propose an alternative solution, (3) Each student has a different Adversity Quotient and this affects the students' ability to think refractively, so the teacher needs to pay attention to the AQ of each student in the class.

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