Snowball Throwing: The Critical Thinking and Self-Efficacy Revolution

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Abstract

The ability to think critically and self-efficacy are essential skills for students in the modern era. However, effective learning methods to improve these two skills remain underexplored. This research evaluates the effectiveness of the snowball-throwing method in improving the critical thinking skills and self-efficacy of vocational school students. This research involved class X students in one of the Bandung City Vocational Schools as samples. The method in this research uses the Embedded mixed method which is collected through test questions, observations, questionnaires, and interviews. The research results showed that Snowball Throwing significantly improved critical thinking skills, as seen from increased student analysis, evaluation, and synthesis. Apart from that, students' self-efficacy also increases, marked by increased self-confidence in completing assignments and facing challenges. This conclusion indicates that Snowball Throwing is an effective learning method for improving critical thinking skills and self-efficacy in vocational schools.

Keywords: Active Learning, Critical Thinking, Educational Revolution, Self-Efficacy, Snowball Throwing

How To Cite: Jumari, E.O.(2024). Snowball Throwing: The Critical Thinking and Self-Efficacy Revolution. Pasoundan Journal of Mathematics Education: Jurnal Pendidikan Matematika, 14(2), 95-111. 10.23969/pjme.v14i2.16551

INTRODUCTION

Mathematics is a science that deals with abstract objects, which require a high level of reasoning and rely on deductive thinking. This nature of mathematics demands critical thinking, allowing students to analyze, evaluate, and create new understanding based on the given information. Critical thinking in mathematics is essential for students to approach problems methodically and effectively. expressed by Yaniawati et al (2019) revealed that in addition to mathematical problem-solving skills, self-regulated learning is also an important component that is important in learning mathematics. Self-regulated learning also determines student learning achievement.In line with this, self-efficacy, or a student's belief in their ability to succeed in specific tasks, plays a crucial role in their learning process. According to Prayekti et al. (2020), students' mental models in solving mathematical problems evolve, reflecting their understanding and self-confidence, which are integral to critical thinking. Yaniawati et al. (2019) emphasized that students' ability to engage in critical thinking directly impacts their success in overcoming mathematical challenges, highlighting the significance of self-efficacy in this context.

The basic ideas of mathematics consist of abstract elements, reasoning, and models, along with principles related to the ideas and ways of thinking of people who study mathematics (He & Shen, 2022). These elements require a deep level of cognitive engagement, making critical thinking an essential component in understanding and applying mathematical concepts. In mathematics, critical thinking involves analyzing problems, recognizing patterns, and making reasoned decisions based on abstract principles. Therefore, critical thinking skills are crucial in mathematics education, especially in the Industrial Revolution 4.0 era, where complex problem-solving and innovation are highly valued. Also revealed by Nurdina et al (2024) that critical thinking is also a step of effective thinking possessed by someone so that it can make, assess, and carry out decisions that are relevant to what he believes and does.

Devika and Soumya (2016) revealed that students who have critical thinking skills will achieve many things in solving life's problems, while Chasanah (2019) added that critical thinking skills, problem solving, creativity, innovation, communication and collaboration are 21st century skills that must have.

However, similar challenges in critical thinking skills have been observed not only in Banda Aceh but also in other regions, including Bandung. Research conducted in a vocational school in Banda Aceh revealed that low participation and poor mathematics learning outcomes were linked to students' lack of critical thinking skills when solving mathematical problems. This issue is exacerbated by conventional learning methods that prioritize curriculum demands, which often result in passive student engagement (Capar & Tarim, 2015; Deslauriers et al., 2019; Govindarajan & Goh, 2021). These findings suggest a broader trend that may also be relevant to the students in Bandung, indicating the need for educational strategies that foster active participation and critical thinking.

To overcome this problem, the use of innovative learning models such as snowball throwing has proven effective. Several studies (Manulu et al., 2022 ; Aliah et al., 2023 ; Ofridaningsih et al., 2023) state that the snowball throwing learning method is effective in supporting students' active learning in class, with posttest results in the very good category. Mathematics learning using the snowball throwing model on the topic of comparing trigonometry to right triangles shows a significant increase in students' mathematical critical thinking abilities at the final learning (posttest) with the lowest score being 50 and the highest being 100. Susanti's (2017) research found the same thing, shows an increase in critical mathematical thinking in the final learning.

The importance of critical thinking activities in mathematics learning is also related to students' self-efficacy . Self-efficacy or self-confidence is an important factor in achieving academic achievement, as stated by Sopari et al. (2022). Research by Nurazizah and Nurjaman (2018) and Misbahudin (2019) shows that there is a significant relationship between self-efficacy and critical mathematical thinking abilities. In other words, critical thinking requires an attitude of self-efficacy.

However, students' self-efficacy is often low, which affects their learning process and learning outcomes (Bartimote et al., 2016; Domenech et al., 2017; Cheng, 2020). Bartimote et al. (2016) stated that there is a strong relationship between self-efficacy and student learning outcomes, and this can be improved through teaching strategies. Research by Muhtadi, Assagaf, and Hukom (2022) shows that the higher the self-efficacy, the higher the mathematical ability, and vice versa. Students' beliefs in their expected values serve as a link between academic success and the relationship between achievement and self-satisfaction (Domenech et al., 2017). Hwang (2021) also emphasized that self-efficacy is an important indicator of student engagement in learning. Self-efficacy consists of three dimensions: magnitude, strength, and generality (Hendriana et al., 2017; Rahmi et al., 2020; Sopari et al., 2022).

Snowball throwing learning model is considered appropriate for improving students' mathematical critical thinking skills and self-efficacy. Manurung et al. (2019) stated that cooperative learning using the snowball throwing type creates a pleasant atmosphere so that students have motivation to learn, avoid anxiety, and are more creative. Satiawy (2023) added that snowball throwing trains students to be more responsive in receiving and conveying messages in groups, which ultimately improves critical mathematical thinking skills.

Interactive and participatory learning is very important in improving students' critical abilities and self-efficacy. Wright (2020) revealed that participatory action research can change classroom practices, mathematics education, and students' critical mathematics abilities. The snowball-throwing model provides a platform where students can be more active and involved in the learning process. They not only learn from the material provided by the teacher but also from interactions with their friends.

Research by Munawaroh and Kurniasih (2016) and Syahrina and Wahyuni (2016) shows that using the snowball-throwing model can improve students' mathematical critical thinking abilities. By using this model, students are encouraged to be more active in solving problems and discussing and evaluating the solutions they find with their friends. Research by Manulu et al. (2022) shows that the Snowball Throwing learning model increases student activity and learning outcomes, with an increase of 65.6% in the active category and 95.6% in the very active category.

Apart from improving critical mathematical thinking skills, the snowball-throwing learning model can also increase students' self-efficacy. By being actively involved in the learning process, students become more confident in their ability to understand and solve mathematical problems. This self-confidence is important because it influences students' learning motivation and overall academic achievement.

This research offers a new approach in improving critical thinking skills and self-efficacy through a fun and interactive learning model. The snowball throwing model provides a different learning experience, where students are actively involved in the learning process, motivating them to think critically, and strengthening their self-confidence. This is different from previous research which focused more on conventional methods or other less interactive learning models.Thus, this research aims to analyze the improvement of students' mathematical critical thinking and self-efficacy profiles through the snowball-throwing learning model in class and student self-efficacy. Overall, this research offers a practical solution to overcome the problem of low critical mathematical thinking skills and self-efficacy in mathematics learning. By using the snowball-throwing learning model, it is hoped that students will not only be able to improve their mathematical critical thinking skills but also increase their self-confidence and self-efficacy in learning. In recent years, there has been growing interest in innovative teaching methods that can enhance students' critical thinking skills in mathematics. Among these methods, the "Snowball Throwing" learning model stands out for its interactive and participatory approach, which contrasts with the more traditional, teacher-centered conventional methods. Critical thinking is essential for students, especially in the context of the Industrial Revolution 4.0, where problem-solving and analytical skills are highly valued. Despite the potential benefits of interactive learning models, conventional teaching methods remain prevalent, often leading to passive learning environments.

This study aims to compare the effectiveness of the Snowball Throwing model with conventional methods in improving students' mathematical critical thinking abilities. By examining the impact of these two approaches, the research seeks to provide insights into the best practices for fostering critical thinking in mathematics education. This research also seeks to enrich the literature regarding the effectiveness of cooperative learning models in mathematics education. With the expected results, this research can be a reference for educators in implementing more effective and enjoyable learning methods in the classroom.

Ultimately, it is hoped that this research can provide new insights into innovative ways to improve the quality of mathematics learning at the vocational school level. In this way, it is hoped that students will be better prepared to face academic and real-life challenges with critical mathematical thinking skills and better self-efficacy.

METHOD

Based on the existing problems, the research method that will be used in this study is a quantitative and qualitative approach with the Embedded Design (Indrawan and Yuniawati, 2014). This research was conducted in a class X vocational school in Bandung City, West Java Province. Class X was chosen as the sample because students at this level are transitioning from middle school to a more specialized vocational curriculum, making it a critical stage for developing essential skills like critical thinking. The subjects of this research were 32 students, randomly selected from a total of 120 students in the class. This sample size was chosen to ensure a representative mix of student abilities while allowing for manageable data collection through written tests and questionnaires.

This study employs a comparative approach to evaluate the effectiveness of the Snowball Throwing learning model versus conventional teaching methods in developing students' mathematical critical thinking skills. The research was conducted at a vocational school in Bandung City, West Java Province, involving two groups of students: one taught using the Snowball Throwing model and the other with conventional methods. A total of 65 students participated, with 32 students in the Snowball Throwing group and 33 students in the conventional group, randomly selected to ensure diversity in skill levels.

To assess the impact of the different teaching methods, a pretest-posttest design was used. At the beginning of the study, both groups were given a pretest consisting of six essay questions designed to measure their initial level of mathematical critical thinking ability. These questions were categorized into three main indicators: Coherence, Elementary Clarification, and Basic Support. After the intervention, a posttest with similar questions was administered to evaluate any improvement in critical thinking skills.

The quantitative data from the pretest and posttest were analyzed using the N-gain method to measure the improvement in critical thinking skills for each indicator. Additionally, qualitative data were gathered through student reflections and thematic analysis was used to identify any underlying patterns in their responses.

A self-efficacy questionnaire was also administered before and after the intervention to assess changes in students' confidence in their mathematical abilities. The questionnaire included 20 items, with 18 validated through reliability testing, and used a Likert scale for responses. The combination of pretest-posttest data and qualitative insights provides a comprehensive understanding of how the two teaching methods influence students' mathematical critical thinking skills and self-efficacy.

Instruments used to measure students' mathematical critical thinking ability included a test consisting of six essay questions, designed to assess specific indicators of critical thinking such as analysis, evaluation, and inference. Of the six questions, five were validated based on expert judgment and item analysis. The self-efficacy questionnaire was employed to gauge students' confidence in their ability to solve mathematical problems, focusing on aspects such as task difficulty, effort, and perseverance. This instrument consisted of 20 items, with 18 validated through a reliability test. The research procedure involved the preparation of these instruments, administering the written tests, having students complete the questionnaires, and analyzing the collected data. Detailed grids (kisi-kisi) of both the test instruments and questionnaires, along with the indicators of critical thinking skills and self-efficacy, are elaborated in the introduction, supported by relevant sources and methods.

Data analysis was carried out using statistical methods for quantitative data and thematic analysis for qualitative data. This research aims to provide a comprehensive picture of students' critical mathematical thinking abilities and self-efficacy in the context of mathematics learning. The quantitative data were analyzed using the N-gain method to measure the improvement in critical thinking skills, while the Likert scale was used to assess students' self-efficacy. For qualitative data, thematic analysis was employed to identify and interpret patterns or themes that emerged from students' written responses and reflections, allowing for a deeper understanding of their thought processes and confidence levels.

The results of the N-Gain calculation can be categorized into three levels, namely: (1) high category if N-gain ≥ 0.7; (2) Medium category, if 0.3 ≤ N-gain < 0.7; and (3) low category, if N-gain < 0.3 (Majdi & Subali, 2018).

RESULTS AND DISCUSSION

Mathematical Critical Thinking Ability

Based on research conducted, it was found that students who used the Snowball Throwing learning model had a higher average n-gain than students who used the conventional model. The results of this research are presented in the following table.

Table 1. Description N-gain Mathematical Critical Thinking Ability

Learning model	N	Average	Standard Deviation
Snowball Throwing	32	0.46	0.15
Conventional	33	0.34	0.17

Based on **Table 1**, it can be defined as the n-gain criteria for students who use the snowball throwing model whose mathematical critical thinking abilities are included in the high improvement category. This means that students who learn with the snowball-throwing model show a significant increase in mathematical critical thinking abilities. Meanwhile, students who used the conventional learning model had a lower average n-gain than students who received snowball-throwing learning, which was included in the moderate improvement category. This means that although there is an increase in critical mathematical thinking skills in the control class, the increase is not as big as in the experimental class. This was also found in research (Oktaviana, 2017; Siahaan, and Lubis, 2019; Badwi, 2019; Husein,2021; Yampap and Kaligis, 2022) that the mathematical critical thinking abilities of students who received snowball throwing learning treatment were better than conventional learning.

In addition to looking at critical thinking descriptively, the results of students' mathematical critical thinking tests also need to see the difference in the average increase in N-Gain. After statistical tests were conducted, the results of the test of the average difference in the increase in mathematical critical thinking between snowball throwing and conventional learning, the results of the test are summarized in the following table.

Table 2. Different Test of Mathematical Critical Thinking Ability

Test Value = 0			
t	**df**	**Sig. (2-tailed)**	**Mean Difference**
30.475	64	.003	.85198

The results of the test of the difference in the increase in mathematical critical thinking show that H_0 is rejected. This means there is a significant difference in the average increase in mathematical critical thinking between students who receive snowball-throwing learning and those who receive conventional learning. This indicates that snowball-throwing learning is superior to conventional learning in improving students' mathematical critical thinking. Bukit et al., (2023) revealed that the snowball-throwing learning model fosters students' ability to ask questions and encourages students to provide answers and explanations so that they are more critical in thinking. This significant difference in average n-gain indicates that learning methods that are more interactive and actively involve students, such as Snowball Throwing, can improve students' understanding and skills. According to research by Kusumaningrum et al (2019), it was found that the snowball-throwing model significantly increased students' psychomotor mastery and abilities. The snowball-throwing learning model has a significant effect on students' speaking skills (Yusmi et al., 2021; Hasanah et al., 2021). However, although the distribution in Snowball Throwing is more varied, a higher average n-gain indicates better overall effectiveness.

The effectiveness of the learning model can be analyzed further by looking at the difference in average n-gain between the two methods. With an average n-gain difference of

0.38, the Snowball Throwing learning model shows a significant increase in students' understanding and skills. The higher n-gain increase in the snowball-throwing learning model may be due to a more collaborative and dynamic learning approach (Manulu et al., 2022). Learners are invited to actively participate in the learning process, which increases their involvement and motivation.

The mathematical critical thinking ability test is given, so that the test results are grouped into three indicators, namely Coference, Elementary Clarification, and Basic Support. According to Nurdin et al (2022), students who have high mathematical abilities have higher critical thinking abilities, while students who have moderate mathematical abilities can also formulate the main problem, reveal existing facts, and determine the theorems to be used.

The results of this research indicate that the Snowball Throwing learning model is more effective in improving students' critical mathematical thinking skills compared to conventional learning models. For more depth, additional explanations will be provided for each indicator to increase understanding. The conversation is based on the following metrics:

a. Making conclusions (Conference)

In this indicator, the N-gain value of experimental class students is higher than that of the control class, with a value of 0.49 for the experimental class and 0.29 for the control class. The interpreted N-gain value for the experimental class is moderate, while the interpreted value for the control class is moderate. Moreover, almost all students in the experimental class could solve the problems. The form of the combined questions and examples of student answers can be seen in **Figure 2** and **Figure 3**.

Sebuah kipas angin berputar dengan kecepatan 36 putaran. Nyatakan kecepatan putaran kipas angin tersebut:

a. Dari derajat ke radian dan dari radian ke derajat
b. Buatlah kesimpulan pendapat anda

1. a). dari derajat ke radian
$= 36 \times 360 = 12960°$
$= \frac{12960°}{180°} \times 3,14 = 226,08$ rad
dari radian ke derajat
$= \frac{226,08}{3,14} \times 180° = 12960°$
* Kesimpulan dalam 1 putaran kipas angin berputar sebanyak 226,08 radian atau 12960°

b.) dari derajat ke radian
$= \frac{x}{180°} \times \pi$
dari radian ke derajat
$= \frac{x}{\pi} \times 180°$

Figure 2. Question and answer Number 1

In test students are asked to explain the relationship between radians and degrees as units of measurement of angles, as shown in **Figure 2** . However, some students made the wrong conclusion, which means that questions 1a and 1b did not correctly explain the relationship between radians and degrees as units of measurement for angles.

Tentukan nilai trigonometri berikut ini:

a. sin 30
b. sin 240
c. cos 315

3. a. $\sin 30° = \frac{1}{2}$
b. $\sin 240° = \sin(180 + \_\_\_)$
$= 60°$
$= \sin 60° = -\frac{1}{2}\sqrt{3}$
$\sin 240 = -\frac{1}{2}\sqrt{3}$
c. $\cos 315° = \cos(360° - \_\_\_)$
$= 45°$
$= \cos 45° = \frac{1}{2}\sqrt{2}$
$\cos 315° = \frac{1}{2}\sqrt{2}$

Figure 3. Question and Answer Number 3

In **Figure 3**, question and answer shows that students are asked to generalize trigonometric ratios to related angles. Although some students made wrong conclusions in answering this question, they were still unable to provide the right conclusions and accurate answers. Thus, students must already understand what they have to do.

b. Provide a simple explanation (Elementary Clarification)

In this indicator, the N-Gain value of experimental class students is lower than that of the control class, with a value of 0.22 for the experimental class and 0.28 for the control class. The N-Gain value for the experimental class is considered high, while the N-Gain value for the control class is considered medium. Moreover, almost all students in the experimental class could solve the problems. **Figure 4** and **Figure 5** show the form of basic explanation questions and examples of student answers.

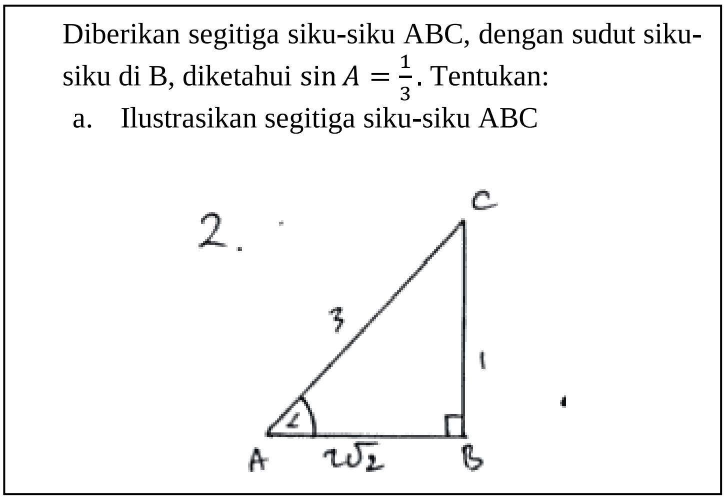


Figure 4. Question and answer Number 2a

Figure 4 shows the questions and the results. Students are asked to explain trigonometric ratios (sine, cosine, tangent, cotangent, secant, and cosecant) in right triangles by showing a picture of the triangle. However, some students have not answered correctly, indicating that they cannot describe a right triangle correctly or provide information.

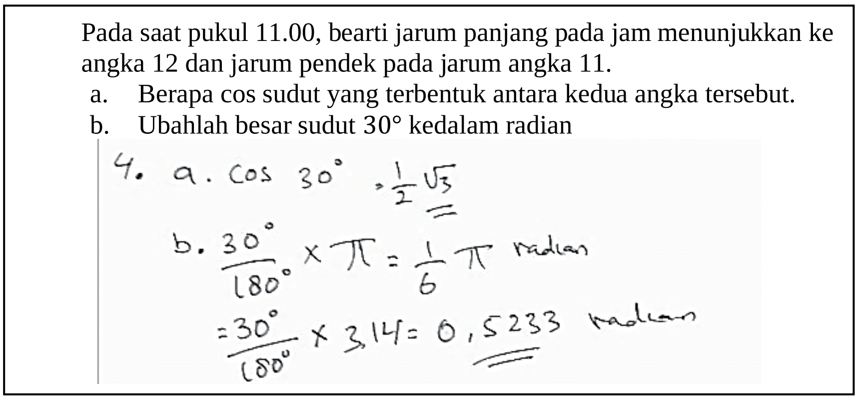


Figure 5 . Question and Answer Number 4

Figure 5 shows that question and answer results where students are asked to use the concept of angle conversion (degrees to radians) to solve the problem. However, some students make mistakes in answering this question because they cannot provide a simple explanation of their answer so they can understand what they have to do. In other cases, question number 4 asks students to apply the concept of angle conversion. According to Pruthi et al (2020), explanations from teachers can help students by providing increased accuracy in student models that are trained to simulate the teacher's model. To show that an explanation is necessary, provide an explanation that improves our understanding or makes the phenomenon more likely to occur (Jakobsen, 2020).

c. Basic skills (Basic Support)

In this indicator, the N-Gain value of experimental class students is higher than that of the control class, with 2.52 for the experimental class and 0.62 for the control class. The N-Gain value for the experimental class is also considered high, while the N-Gain value for the control class is also considered high. Thus, almost all students in the experimental class were able to solve the problem.

Diberikan segitiga siku-siku ABC, dengan sudut siku-siku di B, diketahui $\sin A = \frac{1}{3}$. Tentukan $\cos A, \tan A, \sin C,$ dan $\cot C$ (jelaskan jawaban anda)

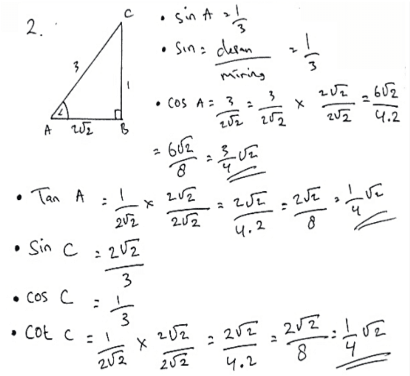
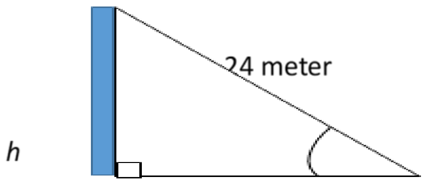


Figure 6 . Questions and answers number 2b

Figure 6 shows the form of basic supporting questions, as well as examples of students' answers to question and the results of answer. In the test, students are asked to determine the trigonometric ratio values (sine, cosine, tangent, cosecant, secant, and cotangent) in a right triangle. There are some students who are not correct in answering this question, and some are still unable to use skills in solving problems.



Sebuah tali yang panjangnya 24 meter setelah diikatkan pada ujung tiang ke permukaan tanah yang membentuk sudut 55^o. Tiang dan tanah membentuk sudut 90^o dengan tingginya h meter. Berapakah tinggi tiang sesungguhnya? (**cos 55 =**

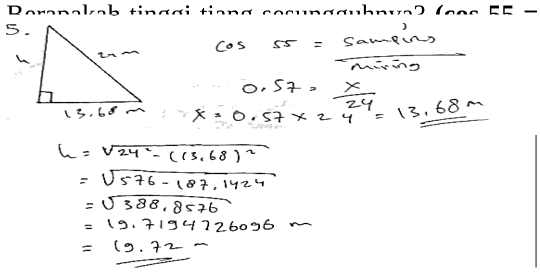
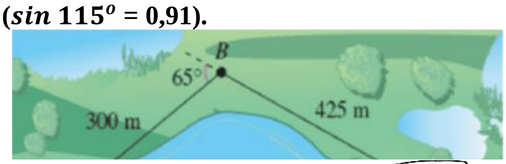


Figure 7 . Question and Answer Number 5.

Pada saat mensurvei sebidang rawa-rawa, seorang pensurvei berjalan sejauh 425 meter dari titik A ke titik B, kemudian berputar 65^o dan berjalan sejauh 300 meter ke titik C (lihat gambar di bawah ini). Hitung jarak dari A ke C dengan pemahaman anda. **($sin\ 115^o$ = 0,91).**



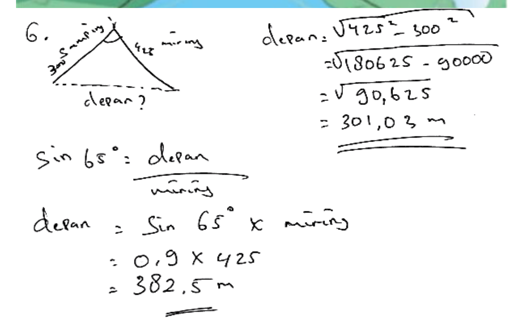


Figure 8 . Question and Answer Number 6.

The form of supporting basic skills questions and examples of student answers can be seen in **Figure 7** and **Figure 8.** It is hoped that students will be able to solve contextual problems and contextual problems related to trigonometric ratios of angles in various quadrants using the concepts of sine, cosine, tangent, cosecant, secant, and cotangent. . However, some students have given the right answers, while others have not been able to use their basic skills. In contrast to Umezu et al (2023) who stated that programming skills do not really depend on mathematical ability, but more on how seriously someone is involved in learning.

The description questions show that students with good mathematical thinking skills have a high level of critical thinking, students with sufficient mathematical skills have a moderate level of critical thinking, and students with low mathematical skills have a low level of critical thinking. This is clearly a component that influences student self-confidence. This is in line with research conducted (Tresnawati et al., 2017) which found that student self-confidence of 74,6% influenced students' mathematical critical thinking abilities in high school with a positive impact, while other factors besides student self-confidence influenced 25,4%.

In addition to students' sense of self-confidence, there are additional influences. The cooperative learning model has a significant influence on students' critical thinking abilities. As per research from Vishnuka (2021), cooperative learning has a significant impact on critical thinking skills, resulting in better performance compared to traditional methods. Apart from its significant impact on critical thinking skills, cooperative learning effectively develops and improves students' critical thinking skills in writing argumentative essays (Romadhoni, Andania, & Yen, 2022).

Based on the research results, teachers and educators can consider adopting the Snowball Throwing learning model as an alternative or addition to their learning strategies, especially in an effort to increase students' understanding and skills. The Snowball-Throwing learning model can be applied to various subjects to create a more interactive and challenging learning atmosphere.

It is recommended to conduct further research with larger samples and a variety of different learning conditions to ensure consistency of results. Combining the Snowball Throwing learning model with other methods that also focus on active student participation can further improve learning outcomes.

The Snowball Throwing learning model is proven to be more effective in increasing students' n-gain compared to conventional learning models. This provides insight for educators to adopt more interactive and participatory learning methods to improve the quality of education.

Self Efficacy Profile

According to the results of descriptive statistical analysis of self-efficacy profile data for class These results are presented in the form of a self-efficacy score frequency graph. The following shows the distribution and presentation of each self-efficacy score category in **Figure 9**.

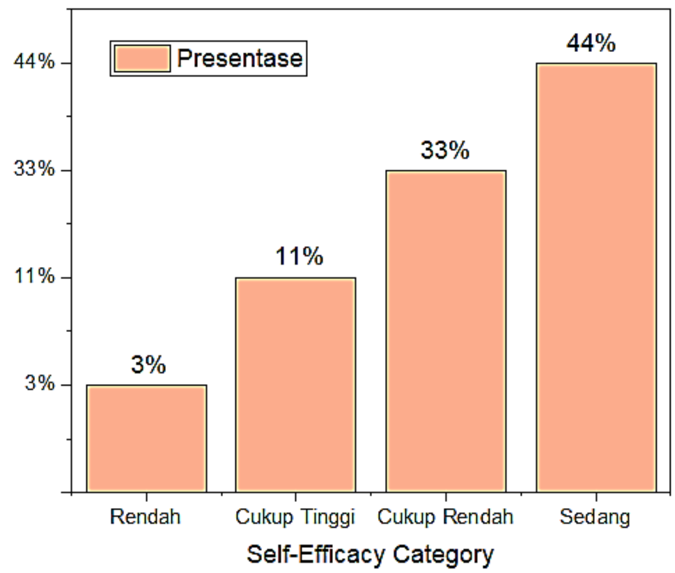


Figure 9 . Self-Efficacy Frequency Chart

Figure 9 illustrates the distribution of students' self-efficacy scores following the implementation of the snowball-throwing learning model. The chart provides a visual representation of how students' self-efficacy is categorized into different levels.

The self-efficacy scores are classified into the following categories: Very Low Self-Efficacy, Low Self-Efficacy, Moderate Self-Efficacy, High Self-Efficacy, and Very High Self-Efficacy. These categories are adapted from Bandura's (1997) self-efficacy theory, which defines self-efficacy as individuals' belief in their capability to perform tasks and achieve goals. The specific thresholds for categorizing self-efficacy levels were derived from established scales used in educational psychology (e.g., Schunk, 2003; Pajares, 2006).

The data in Figure 9 reveals that, after the implementation of the Snowball Throwing model, no students were categorized in the Very Low Self-Efficacy category, and only 3% were classified as Low Self-Efficacy. This indicates an improvement from the baseline self-efficacy levels observed before the intervention. Prior to the study, a preliminary survey indicated that a significant proportion of students exhibited low to moderate self-efficacy levels in mathematics, which underscores the need for effective instructional strategies to boost students' confidence.

The Snowball Throwing learning model has demonstrated potential in enhancing students' self-efficacy in mathematics. However, there remains an opportunity for further improvement. Additional efforts and refinements in instructional practices are necessary to achieve even higher levels of self-efficacy among students.

High self-efficacy is because students who have high self-efficacy can plan effectively and succeed in preparing and completing a task (Firmansyah et al., 2020). Apart from that, students who have high self-efficacy also believe in their abilities and are confident that they can apply them in such a way that they achieve their goals and even complete their assignments well.

This is different from other research which states that subjects with low levels of self-efficacy use their own thinking and produce formulas to solve problems (Askar et al., 2016). According to Loviasari and Mampouw (2022), students' high or low abilities do not always have a negative effect on students' efficacy attitudes in solving problems.

The findings above are also strengthened by the findings made by Reflina (2018) which states that there is a link between problem-based learning and Self-Efficacy, for example when students are given a problem according to the Self-Efficacy indicator, they feel confident they can carry out and complete the task and make it an experience. life as a way to achieve success. So it can be concluded that the problem-based learning model can influence students' Self-Efficacy. Learners those guided by groups or cooperatives can increase self-efficacy and learning outcomes (Yolanda, 2019; Puspaningtyas et al., 2021).

self-efficacy profile was also stated by Wahyuni's (2022) research that by using the snowball throwing cooperative learning model in the classroom, students' self-efficacy or self-confidence can increase compared to before they were given treatment. Apart from that, self-efficacy also increases with supporting factors, one of which is the growth of students' mature thinking patterns and self-regulation (Prihandoko and Nurkamto, 2022).

The Snowball-Throwing learning model is able to influence students' self-efficacy, although there is still a fairly low self-efficacy category that needs attention. Therefore, there is a need for additional strategies to increase students' overall self-efficacy. This is important so that they are more confident in facing the challenges of learning mathematics and can achieve better results.

CONCLUSIONS

Based on the analysis and results of this study, it can be concluded that the level of students' mathematical critical thinking skills shows significant variation, especially in students who use the Snowball Throwing learning model, where high-level critical thinking skills are most widely possessed. This study involving 65 students shows that interactive learning methods that actively involve students, such as Snowball Throwing, are able to improve students' understanding and skills better than conventional learning models.

Furthermore, the results of this study show that there is a significant difference between students who receive Snowball Throwing learning which is more effective in improving students' mathematical critical thinking skills than those who receive conventional learning, so it can be concluded that students who learn using this model have better mathematical thinking skills. However, the analysis also shows that the student's self-efficacy profile in learning with this model is in the moderate or sufficient category. This shows that although there is an increase, there is still a category of self-efficacy that is quite low so that it needs more attention.

Therefore, this study recommends the need for additional strategies to improve students' overall self-efficacy. This step is important so that students can be more confident in facing the challenges of learning mathematics and achieving better results.

The implications of this study underline the importance of implementing interactive learning models in the education curriculum to stimulate students' critical thinking skills. However, this study also has limitations, including the limited number of respondents and not considering other external factors that may affect student learning outcomes. Overall, this study contributes to the development of science in the field of education, especially in understanding the relationship between learning methods and critical thinking skills, as well as the importance of developing student self-efficacy in the teaching and learning process.

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