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Behavioral Indicators of Self-Efficacy in Pólya's Mathematics Problem-Solving Stages

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ABSTRACT

This study aimed to determine self-efficacy indicators in each stage of George Pólya's method of problem-solving. Pólya's method (Understanding the problem, Devising a Plan, Carrying out the Plan, and Looking Back) was used as it provides clear, structured, and widely accepted framework for solving math problems. The research design used was qualitative research design to collect and analyze its data. Entire section of thirty-three (33) Grade-8 students was observed during math discussions and problem-solving activities. Possible behaviors and actions that may indicate high or low self-efficacy were noted by the observers. These indicators are then confirmed through semi-structured interview conducted to nine (9) students coming from thirty-three (33) observed students. From these interview participants, five (5) demonstrates high self-efficacy and four (4) were low self-efficacy. This categorization was based on the General Self-Efficacy Scale that was administered to the students during observation. The result of the analysis shows the contrasting perspective between the two groups, students who demonstrates high self-efficacy answered positively to the majority of the questions which confirms that they possess these behaviors. Conversely, students who demonstrates low self-efficacy responded passively/negatively to most of the given questions, confirming that the behavior recorded reflects student's self-efficacy across stages of problem solving. Although, it was noticeable that the two groups did not absolutely answer negatively or positively to all questions. Supporting the notion that self-efficacy level of students, will not ultimately dictate that they will have the same level of self-efficacy on other stages of problem-solving. Overall, this study determined four (4) self-efficacy indicators in each stage of Pólya's method of problem-solving totaling to sixteen (16) self-efficacy indicators.

Keywords: George Pólya, Problem-Solving Stages, Mathematics Problems, Self-Efficacy, Self-Efficacy Indicators.

1. INTRODUCTION

Self-efficacy is defined to be the confidence to be effective in specific discipline (Bandura, 1977). This construct plays a major role in the cognitive abilities and the mathematical problem-solving performance of the students (Fakhrou & Habib, 2021), making it an important construct to understand and study. According to Liu (2023), self-efficacy is not a stable trait and may fluctuate across stages of problem-solving, meaning a high self-efficacy student may demonstrate high level of self-efficacy in one stage of problem solving but may not exhibit the same level of self-efficacy in other stages. The same variability also happens to students who demonstrates low self-efficacy in problem solving.

Numerous studies proved that self-efficacy can influence the success of students in problem-solving (Honicke & Broadbent.2016; Soraya & Karim, 2024; Herianto,2024). However, when it comes to self-efficacy indicators in specific stages of problem-solving, there is a lack of information about behaviors that may indicate if a student has high or low self-efficacy across stages of problem-solving may give valuable insights to educators and researchers on how to improve the self-efficacy of learners on all stages of problem-solving. To fill this gap, this study aimed to determine self-efficacy indicators across stages of Pólya's method of problem solving.

2. OBJECTIVES

1. To determine specific self-efficacy indicators that are exhibited by students in each stage of Pólya's method of problem-solving.

3. METHODOLOGY

The study used qualitative research design to collect and analyzed its data. For a month, entire section of Grade-8 students was observed during classroom discussions and problem-solving activities in mathematics. During these sessions, the researcher, together with trained colleagues recorded possible self-efficacy indicators during discussions and problem-solving activities. To confirm if the observed indicators are really self-efficacy indicators, a semi-structured interview was conducted. High self-efficacy and low-self-efficacy students were selected to be interviewed to confirm if the observed indicators really do exist/absent within them. The selection was made through General Self-Efficacy Scale that was administered during the observation. These two groups were chosen to have clearer contrast in perspective and behavior. The observed indicators were then transformed into interview questions to be given to the participants of the interview to confirm its presence or absence between the two groups. The analysis used was comparative conceptual analysis, this is to have an in-depth analysis on the contrasting perspective of the two groups providing a clear conclusion whether the recorded self-efficacy indicators during observation are true and not just a random behavior displayed by the students.

4. DATA ANALYSIS

4.1 Analysis on student responses

Stage 1: Understanding the problem

Note: S1 (Student 1)

Indicator: Reading problems carefully

Table 1. Responses from the question "When you solve a math problem, what do you usually do first?"

High self-efficacy	Low self-efficacy
S1: Think of the possible formulas to apply to the problem. Understand the problem.	S6: If there are steps, I follow the steps
S2: I let the problem soak in. I will take my time to understand the question no matter how difficult it is."	S7: I look at the given information, then I solve it."
S3: Usually, I look for what is being asked so I can know my goal..."	S8: If I already know how to answer it or if it's similar to previous lessons
S4: I identify what I should do first—if there are square roots, I do those first."	S9: The first thing I do is look at the problem, then I contemplate whether or not I should cry."
S5: I try to understand the question first, then identify what's being asked.	

Comparative analysis:

High self-efficacy students consistently showed comprehensive and structured approaches to reading and understanding problems. Their responses highlight actions such as identifying formulas, understanding the problem

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first, determining steps, and carefully choosing how to begin. In contrast, Low self-efficacy students also read problems but tended to be less systematic. Some responses showed reliance on recognizing familiar patterns (S8) or even emotional reactions to difficulty (S9), reflecting less confidence in comprehension.

Decision:

This indicator should be included in the self-efficacy tool. Both high and low efficacy students displayed this behavior, though with different levels of depth and confidence. The contrast makes it a valuable marker for distinguishing self-efficacy levels in understanding the problem.

Indicator: Asking Clarifying Questions

Table 2. Responses from the question "If a part of the problem is confusing, who do you usually go to for help? Teacher, classmates, or on your own?"

High self-efficacy	Low self-efficacy
S1: I do it If I think I can manage it or if there's a classmate who knows the answer, I ask them. But if it's really hard, I go to the teacher.	**S6:** Mostly, I approach the teacher so that I can get a clearer explanation.
S2: First, my friends. Then next, the teacher. But if I have available resources that I can use to answer on my own, I choose to answer on my own.	**S7:** On my own.
S3: I ask my friends, but I don't ask for the answer, I just ask how to do it."	**S8:** Classmates, because there are some teachers who can't really explain at the same level
S4: I ask my classmates	**S9:** Usually the teacher, because I don't like asking help from my classmates.
S5: If I really can't figure it out, I go to my classmates or teacher."	

Comparative analysis:

Students with High self-efficacy demonstrated balanced and confident help- seeking behavior. For example, S1 and S2 demonstrated independence and resourcefulness by preferring to question classmates before addressing the teacher. In order to show confidence in their own comprehension, S3 focused on asking solely for advice on how to solve the problem rather than the answer itself. In a similar vein, S5 indicated persistence before depending on others by mentioning asking for assistance only after attempting on their own. Students with poor self-efficacy, on the other hand, showed more reliant ways of asking for assistance. While S8 relied on classmates due to trouble understanding professors' explanations, S6 and S9 preferred to approach the teacher directly, avoiding peer collaboration. However, S7 favored working alone, perhaps due to uneasiness or a lack of confidence while dealing with others. Overall, High self-efficacy students displayed strategic and selective help-seeking, while Low self-efficacy students showed either overdependence on others or complete avoidance, both reflecting lower confidence in their problem-solving ability.

Decision:

This indicator is included in the self-efficacy tool. Asking clarifying questions is a clear indicator of students' regulation during problem comprehension. There may be similarities on how high and Low self-efficacy students

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responded but still their responses provide strong evidence that this indicator can be a marker for self-efficacy level among students.

Indicator: Persistence in Understanding

Table 3. Responses from the question "When a problem feels hard to understand, what do you usually do?"

High self-efficacy	Low self-efficacy
S1: I try my best to understand it... or I look for help online	S6: If my classmates also don't understand, then I go to the teacher.
S2: I let the problem soak in. I will take my time to understand the question no matter how difficult it is. I'll wait until I understand something or maybe something will come to mind."	S7: I read it over and over again until I understand it.
S3: I normally skip it, but if I still have enough time, I try to answer it. If I can't really do it, I skip it.	S8: I look for patterns if it's the same as my own lessons."
S4: I ask the teacher. *What if the teacher is not around?* I will try again till I understand.	S9: I contemplate why I even chose this in the first place
S5: I try my best… I ask friends or look for help online (AI/YouTube)."	

Comparative analysis:

Students with high levels of self-efficacy showed a strong tendency for perseverance, which was usually exhibited by active strategies like experimenting with different approaches, going over the issue again, or using different resources like YouTube or online assistance. Although S3 acknowledged that they occasionally skipped issues due to time constraints, their overall dedication to problem-solving remained noticeably greater than that of their colleagues with lower efficacy. Conversely, students with poor self-efficacy demonstrated more feeble attempts at perseverance, frequently depending on passive strategies like rereading the problem several times, as described by S7, or looking for recognizable patterns, as demonstrated by S8. However, answers like those from S6, who would seek a teacher right away, and S9, who showed obvious irritation and disengagement, illustrate the lack of persistence and demonstrate a lower threshold for resilience when faced with challenges.

Decision:

This indicator should be included in the self-efficacy tool. Persistence is observable in both high and Low self-efficacy groups, but the quality differs: high efficacy students are resourceful when it comes to getting the problem understood while Low self-efficacy students may persist but mostly without strategy with some even expressing hopelessness.

Indicator: Looking and understanding problem at a different angle

Table 4. Responses from the question "Have you ever tried looking at a problem in a different way to understand it better?

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High self-efficacy	Low self-efficacy
S1: Yes sir.	S6: "No." (in response to trying different ways to understand the problem)
S2: Yes" (In response to looking the problem at different views) "Sometimes it's easier to understand, but sometimes, it becomes more confusing."	S7: Sometimes.
S3: I'm simple-minded. If I feel like I can't do it, I don't really try anymore."	S8: Yes, because I already reviewed it before entering
S4: Yes. So like, what I did first was factor them out, which didn't help. It's actually better to simplify it first before factoring	S9: I am physically and mentally incapable of looking at a problem from outside the box
S5: If I feel that the formula I'm using doesn't fit, I try to find another method.	

Comparative analysis:

Students with High self-efficacy generally reported trying different strategies when their initial strategy didn't work. For example, S5 reported trying a different formula, whereas S4 stated simplifying before factoring. Some, like S2, also show an openness to changing viewpoints, even though they were aware that this could occasionally lead to misunderstandings. There was variation in the group as only one student with High self-efficacy, S3, acknowledged giving up easily. Conversely, students with Low self-efficacy demonstrated lower levels of engagement. While S7 and S8 stated that they occasionally thought about other options, others, such as S6, categorically rejected the notion, while S9 stated that they would never contemplate trying a different approach. In general, students with High self-efficacy were more open to trying new things, whereas those with Low self-efficacy preferred to avoid or give up.

Decision:

This indicator should be included in the self-efficacy tool. It clearly distinguishes students who exhibit adaptability by looking into different perspectives to comprehend a problem (a trait of High self-efficacy) from those who avoid alternative approaches or express helplessness (Low self-efficacy). The differences in responses across groups provide strong evidence that this indicator is a valuable marker of problem-solving self-efficacy.

Stage 2: Devising a Plan

Indicator: Verbalizing or Writing strategies

Table 5. Responses from the question "Before you solve, do you usually think about how you might start (a plan/strategy) or do you just try different things right away?"

High self-efficacy	**Low self-efficacy**
S1: I look for a strategy.	S6: I try to recall the process that she taught.
S2: It depends if it's important. If it's just a simple equation, I try to experiment because I like discovering new ways of solving. But if it's really important, I just stick to what I already know.	S7: None. "I go straight into it."
S3: I solve it right away. If what I want to answer doesn't work, I try another method.	S8: Actually, I get overwhelmed at first
S4: Yeah, I try different things right away."	S9: "I just try different things right away
S5: I usually just go with whatever method or formula is related to the topic given."	

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Comparative analysis:

Students with High self-efficacy exhibited intentionality and strategic flexibility: S1 and S5, for example, emphasized the need to find the optimal strategy, while S2, S3, and S4 revealed a clear desire to try new things and modify their approaches after failing. This shows an underlying trust in their capacity to negotiate and adjust to the demands of the challenge. Students with Low self-efficacy, on the other hand, showed a shaky relationship with planning. Their methods were distinguished by their dependence on teacher-given, recalled procedures from S6, their avoidance of verbal strategizing from S7, and their sense of overwhelm during the planning phase from S8. S9 indicated experimenting with various methods, but this lacked the deliberate guidance observed in the high-efficacy group: instead, it resembled unstructured trial- and-error rather than a confident, flexible approach.

Decision:

This indicator should be included in the self-efficacy tool. It effectively differentiates between students who approach planning with confidence and adaptability versus those who avoid strategizing or depend solely on rote methods, making it a strong marker of problem-solving self-efficacy

Indicator: Suggesting multiple strategies

Table 6. Responses from the question "Sometimes there are many ways to solve a problem. How do you usually choose what to do?

High self-efficacy	Low self-efficacy
S1: Simplest way	S6: If the problem is from a lesson, I try to recall it. And I also try different ways if I think it will help solve the problem.
S2: If my first plan doesn't work... Try again.	S7: The simplest way to solve it.
S3: If what I want to answer doesn't work, I try another method.	S8: Whatever I'm used to."
S4: Simplest one"	S9: Whatever is familiar to me." / "The one that was taught to me..."
S5: "I choose the simplest one or the method I understand best."	

Comparative analysis:

Students with high self-efficacy tend to emphasize adaptability and perseverance when investigating tactics. For example, S1, S4, and S5 stressed purposefully selecting the simplest or most efficient technique from the outset, whereas S2 and S3 explicitly stated considering different approaches when the initial attempt failed. This behavior shows a desire for efficiency in their planning as well as the ability to adapt. Conversely, in Low self-efficacy students like S7, S8, and S9 they relied more on well-known or teacher-taught techniques. This was the exception, even though S6 mentioned being open to trying new things. In contrast to their High self-efficacy peers' confident experimentation, the Low self-efficacy group's replies generally point to a more constrained strategic exploration and a reliance on routine procedures.

Decision:

This indicator should be included in the self-efficacy tool. The responses clearly distinguish High self-efficacy students, who demonstrate adaptability and readiness to switch strategies, from Low self-efficacy students, who rely more on habitual or guided approaches. This difference makes it a meaningful marker of self- efficacy in the planning stage.

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Indicator: Adjusting plans without discouragement

Table 7. Responses from the question "If your first idea doesn't work, what do you usually do next?"

High self-efficacy	Low self-efficacy
S1: Think of possible ways or plans, formulas that can solve the question. Never give up, sir.	S6: I try another method or rule to see if it fits the problem."
S2: Plan B... Try again."	S7: Try different one.
S3: If it doesn't work, I go back and try again."	S8: Look for errors or I give up.
S4: I solve it again using a different approach	S9: I just look at the problem again, then I give up."
S5 I reset my work and try again using a different approach or perspective."	

Comparative analysis:

High self-efficacy students have always expressed resilience when their first attempts on solving the problem fails. All of them have shown no discouragement and will try different approaches to solve the problem. For Low self-efficacy students, some of them also tried another approach to solve the problem, but this time with signs of giving up like S8. Meanwhile, S9 expressed complete discouragement by giving up when initial attempts failed.

Decision:

This indicator should be included in the self-efficacy tool. The strong divide between High self-efficacy students who persist and Low self-efficacy students who tend to give up provides clear evidence that resilience in adjusting plans is a reliable marker of self-efficacy.

Indicator: Collaborates with peers

Table 9. Responses from the question "When working with classmates, do you like to share your ideas, listen to others, or do you prefer working alone?"

High self-efficacy	Low self-efficacy
S1: I prefer to work alone.	S6: To help me solve the problem, I listen to others' answers..."
S2: If I'm good at the lesson, it's okay to work alone. But I think it's better to have a group so we can share ideas and knowledge.	S7: If I don't understand the question, mag collaborate. I listen and share my ideas.
S3: I usually answer on my own. But if I'm with classmates who are a bit brighter, I ask them, 'Hey, do we have the same answer here? (when talking to classmates) If not, I look for where I went wrong."	S8: I like to listen to others so I can see the faults in my own ideas.
S4: I like listening to their ideas and also offering help." / "Yes.	S9: There are times when I'm willing to share my ideas... other times I just stay quiet..."
S5: I like to collaborate. I ask questions, listen to their ideas, and also share my own opinions.	

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Comparative analysis:

High self-efficacy students generally displayed openness for collaboration. For S2 and S3, if they are capable of the problem they like to do it alone but if they were allowed to interact, they prefer to collaborate with their classmates. With S4, he likes to listen and offers help when collaborating with someone, with only S1 wanting to do the work alone. For Low self-efficacy students, S6, S7, and S9 also prefer to collaborate but they leaned more toward relying on others to check their mistakes rather than contributing their own to help others, with only S7 really trying to listen and share their own ideas. This comparison shows that even though both groups expressed their drive to collaborate, their reason behind collaboration is different.

Decision:

This indicator should be included in the self-efficacy tool. The difference lies not in whether students collaborate, but in how they collaborate—High self-efficacy students view sharing as mutual and empowering, whereas Low self-efficacy students often use it as support or remain hesitant to share. This nuance makes the indicator valuable for distinguishing levels of self-efficacy in group contexts

Stage 3: Carrying out the plan

Indicator: Persevering despite difficulties

Table 10. Responses from the question "While solving problems, what do you usually do when you make a mistake?)

High self-efficacy	Low self-efficacy
S1: When there's a mistake, I look for where the mistake is. And then, you fix it from there.	S6: If I make a mistake, I try to solve it again and find another way..."
S2: I solve it again and start from where I made a mistake.	S7: Erase then correct.
S3: If I make a mistake, I start again from the beginning."	S8: If it's hard, it is what it is
S4: I go to the previous step and correct the mistake	S9: If it doesn't work at the start, I just stop." "I give up
S5: If it's during an exam, I try my best to solve it, or I skip the question and come back to it later. If I'm at home, I search for similar questions or videos online	

Comparative analysis:

High self-efficacy students expressed their persistence whenever committing a mistake while solving. S1, S2, and S4 described identifying the part where the error was made and rewrote it from there, with S3 even restarting the whole solution if needed and S5 strategically skipping to avoid wasting time and seeking external resources to redo the error made. These responses highlight resilience without a hint of discouragement to persevere despite committing mistakes. In contrast, although some showed resilience to identify and correct their mistakes like S6 and S7, S8 and S9 displayed discouragement when facing errors, ultimately accepting their mistake and not doing anything to correct it. This contrast demonstrates a clear difference in perseverance between the two groups.

Decision:

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This indicator should be included in the self-efficacy tool. Evidence shows that perseverance strongly distinguishes High self-efficacy students, who persist and adapt despite errors, from Low self-efficacy students, some of whom disengage or surrender when challenged.

Indicator: Attempting different approaches

Table 10. Responses from the question "If your first solution doesn't work out, what's your next move usually?"

High self-efficacy	Low self-efficacy
S1: Find another answer or way	S6: I try recalling and I apply what I remembered
S2: It depends. If I have another solution... Oh, sometimes I also try to look at the problem from a different perspective.	S7: Try a different method.
S3: If it doesn't work, I go back and try again	S8: Look for errors in my first idea then I modify it
S4: Solve it again with a different approach.	S9: I give up
S5: I reset my work and try again using a different approach or perspective."	

Comparative analysis:

High self-efficacy students consistently demonstrated adaptability by trying alternative methods when their initial approach failed, as seen with S1, S3, S4, and S5. Some, like S2, demonstrated metacognitive awareness by deliberately choosing to take a proactive approach and see the issue from a different angle. However, even while the majority of students with Low self-efficacy, including S6, S7, and S8, also indicated attempting a different approach, their answers were more mechanical, concentrating on remembering procedures or fixing mistakes rather than being genuinely thoughtful or adaptable. S9, who acknowledged giving up completely, was a striking contrast that highlights the diversity within the Low self-efficacy group.

Decision:

This indicator should be included in the self-efficacy tool. Both groups showed attempts at alternative approaches, but High self-efficacy students did so with greater persistence and creativity, while Low self-efficacy students often relied on routine recall or were prone to disengagement.

Indicator: Staying focused while solving

Table 11. Responses from the question "When you're solving, do you find it easy or hard to stay focused the whole time?"

High self-efficacy	Low self-efficacy
S1: Easy, I can stay focused from start to finish	S6: No
S2: It's easy, as long as I don't let others	S7: No

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distract me.	
S3: It depends on the atmosphere. If it's quiet, I can really focus. But if it's noisy, my focus gets affected. Like I forget what I was doing—for example, instead of writing 6 + 10, I might write 6 × 10 because I got confused.	S8: If I don't know how to answer, then it's hard—I can't focus. But if I know how, I'm 100% focused."
S4: Easy.	S9: I can focus while solving but when it becomes difficult or confusing, I start to feel like, "No, I don't want to do this anymore."
S5: If the problem is hard—like with Kramer's Rule or Row Echelon - I tend to focus more. But if the problem is simple, I get distracted more easily."	

Comparative analysis:

Students with High self-efficacy typically said they could stay focused while tackling problems. S1 reported being able to focus from the start till the end of solving. Students like S2 and S3, however, reported that outside factors affected their ability to concentrate, but S5 discovered that the degree of difficulty had an impact. It's interesting to note that S5 also found more challenging challenges to be more engaging, exhibiting a challenge-seeking behavior when simple tasks caused distraction. Conversely, students in S6 and S7 who had poor self-efficacy often acknowledged that they had trouble focusing. S9 had a similar pattern of conditional concentration that rapidly vanished when issues grew challenging, and S8 reported being able to focus only when they already understood the solution.

Decision:

This indicator should be included in the self-efficacy tool. The differences between high and Low self-efficacy students are clear: High self-efficacy learners adapt their focus based on context and sometimes thrive under challenge, while low self- efficacy learners show avoidance or disengagement when faced with difficulty.

Indicator: Engaging in metacognitive self-talk

Table 12. Responses from the question "(While solving, do you sometimes talk to yourself? (e.g., asking "What should I do next?" or checking your steps)

High self-efficacy	Low self-efficacy
S1: Yes	S6: No, but I talk or ask my classmates like, "what if this is not the correct process?"
S2: Yes, like "What is this?" or "This comes next, then this one."	S7: Yes

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S3: Yes, like murmuring to myself, "What's the answer to 6 + x?" things like that	S8: Yes, I talk to myself… 'Is this wrong? This really seems wrong.'"
S4: I check my steps. So, I'm done with this, I'm done with that. I'm going to do this, I'm going to do this. Like that.	S9: Yes like "What are you doing, self? What is this, self?"
S5: Yes, especially when I can't grasp the question right away	

Comparative analysis:

self-efficacy students all responded that when they are solving problems, they like to self-talk to guide their thought process, whether by verbalizing their calculations, asking themselves problem-related questions, checking steps while solving. This demonstrates strong metacognitive regulation, which can support their way into getting the problem solved. Similarly, among Low self-efficacy students, some also admitted to engaging in self-talk like S6, S7, S8, and S9 but often in ways to express their doubt or frustration towards the problem. This way of self-talking results in discouragement during the process of problem solving.

Decision:

This indicator should be included in the self-efficacy tool. While both groups engaged in self-talk, High self-efficacy students used it as a constructive problem- solving strategy, whereas Low self-efficacy students often associated it with uncertainty or hesitation. This difference highlights its usefulness as a marker of self-regulated problem solving.

Stage 4: Looking back (review)

Indicator: Reviewing solution for correctness

Table 13. Responses from the question "After finishing a solution, do you usually go back and check your answer? If yes, why? If no, why not?"

High self-efficacy	Low self-efficacy
Yes, because for me, I often make mistakes if I don't recheck, so I make sure to check it. I recheck to make sure my answer is correct. answer is correct.	S6: Yes, so I can be sure that my answer is correct."
S2: Yes, because you can never be too sure	S7: Even if I finish everything first, I go back and check my answers afterward."
S3: Yes, I check it to review and see if there's something wrong.	S8: Yes, because my accuracy is not 100%."
S4: If there's time... I recheck	S9: No… because... solving just one problem already takes me a lot of time..."
S5: Most of the time, I don't check unless I feel something is wrong—like if the answer doesn't match other questions I've done before."	

Comparative analysis:

High self-efficacy students displayed mixed behaviors towards reviewing their solution. S1, S2, S3, and S4 routinely check their final answers to ensure it is correct, while S5 only review their work when they feel something is

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off or inconsistent in their solution. Their responses suggest a strategic and self-aware approach of reviewing their final solution. Some review their answers not out of self-doubt but to ensure the correctness of their answers, there are also others who were confident with their final answer and will only review if they felt something was wrong. Meanwhile for low self- efficacy students, S6, S7, and S8 they also review their answers to ensure the correctness of their work due to some (s8) admitting their inaccuracy. However, S9 admitted to skipping the review part since all of her time was used to answer the entire problem. Overall, both groups have shown that they are able to review, the only difference between the two is high-efficacy students' checking was more conditional and strategic, while low-efficacy students relied on it more heavily as a safety net or doubt of their accuracy.

Decision:

This indicator should be included in the self-efficacy tool. While both groups engage in reviewing solutions, the contrast lies in motivation: High self-efficacy students recheck for efficiency or confirmation, while Low self-efficacy students recheck to compensate for uncertainty. This distinction highlights meaningful differences in confidence and strategy between the groups.

Indicator: Identifying and correcting mistakes

Table 14. Responses from the question "When you find mistakes in your work, what do you usually do? (This is after you finish solving and find a mistake"

High self-efficacy	Low self-efficacy
S1: I redo it.	S7: I correct it." / "Depends on how important the question is."
S2: Yes. If I can see my classmates' answers, I'll ask for help like, "How did you do this?" Then I change my solution. But during exams, I redo my solution.	S7: I correct it." / "Depends on how important the question is."
S3: I check my steps one by one and try to find where the mistake is."	S8: Try to remember the mistake… then I ask for help…" / "If it's easy, I re-answer it."
S4: Since I found a mistake, I'm going to do it again. Try to do it in the right way.	S9: If I realize [the mistake]... I retrace my steps... then I redo it..."
S5: First, I try to identify the mistake. If I can fix it, I rewrite that part. But if the mistake is in the whole process, I start over and answer the question again."	

Comparative analysis:

Shown in their responses, High self-efficacy students consistently demonstrated persistence in identifying mistakes and correcting them. S1, S2, S3, and S4 traced the steps of their solution to locate the error and rewrote the incorrect part, and if necessary, restart the whole process to make the whole solution correct without discouragement. This pattern reflects resilience and confidence that despite making errors in the final stage of the solution they are still willing to redo it to make their solutions correct. Meanwhile, for Low self-efficacy students, they are still willing to redo their solutions but it seems like it is dependent on the question. S7 and S8 admitted that they will recheck and redo their answers only if the question is important or if it is easy to redo. This shows that while they are willing to correct their mistakes, some of them are depending it to the type of questions they were currently answering.

Decision:

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This indicator should be included in the self-efficacy tool. Both groups engage in correcting mistakes, but the difference lies in their approaches: High self-efficacy students persist with systematic and independent corrections, while Low self-efficacy students often rely on external support or adjust their effort depending on the task's perceived importance. This contrast highlights the confidence and autonomy that distinguish High self-efficacy learners.

Indicator: Expressing confidence in final answers

Table 15. Responses from the question "After solving, how sure do you usually feel about your final answer?"

High self-efficacy	Low self-efficacy
S1: 75%	S6: I often doubt it."
S2: Not really sure. I am never sure, that's why I recheck my answers.	S7: I feel doubtful... like, 'Is this really the correct answer?
S3: If the problem is easy, I'm 100% sure... But if the question is a bit hard... I just say, Let God handle it.	S8: Zero percent." / "Even with one plus one." / "Most of the time when I get confident, I end up being wrong."
S4: Very sure. Unless I found a mistake	S9: Unless I'm confident... I really worry, 'Was this right? What is this?'"
S5: It depends… But most of the time, I feel confident—unless I feel the need to double-check."	

Comparative analysis:

High self-efficacy students displayed varying degrees of confidence when it comes to their final answers. S1, S4, and S5 generally were confident of their final work, though they acknowledged the need to recheck their work if they felt uncertain on some of their answers. Others like S2 and S3 showed conditional confidence in their final answers, S2 admitted to being unsure to most of her work, relying on rechecking, while s3 felt confident it is only for easier problems. This suggests that while students with high self-confidence display confidence, it is not always absolute, their assurance is paired with caution and self-awareness of their limits. In contrast, Low self-efficacy students openly showed doubt and worry in their final answers. S6, S7, and S9 admitted that they frequently do second-guessing, doubting whether their answers are correct or not. S8 fully claimed that she was never sure of any of her answers and often get wrong answers when she felt sure of her final answer. Their responses demonstrate that Low self-efficacy students tend to feel doubt and worries, relying on external validation or repeated checking to cope with doubt.

Decision:

This indicator should be included in the self-efficacy tool. While both groups acknowledged moments of uncertainty, High self-efficacy students tended to frame their confidence as conditional but generally reliable, whereas Low self-efficacy students characterized their experience with persistent doubt and hesitation. This difference reflects the underlying assurance that separates confident problem-solvers from those with lower self-belief.

Indicator: Explaining solutions/final answer to peers

Table 16. Responses from the question "If someone asks you to explain your answer, how comfortable are you in sharing what you did?"

High self-efficacy	Low self-efficacy

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S1: Comfortable, sir, but sometimes others say I'm bad at explaining, but I really know how to explain—I just don't know how to make them understand.	S6: Not that comfortable
S2: Yes	S7: I get shy, but I'll do it anyway."
S3: I'm okay with that. I'm confident in public speaking."	S8: If the answer is correct, yes. If not, then I'm not comfortable."
S4: Pretty comfortable.	S9: I can focus. I'm okay if a classmate asks help from me... But when it's time to share in front of the class, I can't do that.
S5: I'm comfortable if I really understand the problem. I can show how I solved it."	

Comparative analysis:

The majority of High self-efficacy students expressed confidence and comfort when they are asked to explain their solutions. S1 reported that he is comfortable despite feeling that maybe others can't understand them which shows the will to really share his work and S5 emphasized that he is comfortable to explain their solution especially when he understands the problem. While S2, S3, and S4 showed stronger assurance, with S3 even highlighting his confidence to explain in public. This indicates that students with High self-efficacy are willing to share and justify their work, especially when they feel prepared and knowledgeable. In other hand, Low self-efficacy students displayed greater hesitation and conditional comfort. For example, S6 and S8 admitted that they are not comfortable in sharing their work, particularly when they are unsure of their answers, while S7 acknowledged shyness but still made the effort when asked or needed. S9 felt comfortable to share but may struggle to share in front of the class. These responses suggest that Low self-efficacy students may not be able to share their work/solutions even if they are asked to, due to the fear of correction from others, reflecting less stable confidence compared to High self-efficacy students.

Decision:

This indicator should be included in the self-efficacy tool. High self-efficacy students demonstrate greater readiness and assurance in explaining their solutions, while Low self-efficacy students show conditional or situational comfort, often hindered by self-doubt or anxiety about making mistakes. The contrast underscores how self- efficacy not only affects problem-solving but also influences students' willingness to communicate and justify their reasoning to others.

4.1 Conclusion of the Analysis

Overall, the analysis made it clear that the self-efficacy indicators compiled from various related studies and the ones observed by the researcher and his colleagues during classroom observations were confirmed by the participants involved in the interview. The contrasting answers between high and low self-efficacy students in each self-efficacy indicator are clear evidence that they exhibit or refrained the said indicators.

In addition, high self-efficacy students tend to answer positively towards questions pertaining to specific indicators but it can be noticed that these high self- efficacy students also gave negative responses to some indicators. It is also the same for low self-efficacy students, most of them answered negatively/passively towards most of the questions but can be noticed that on some questions they responded positively. The point being, students with high or low self-efficacy are not guaranteed to have a consistent level of confidence across stages of problem solving, there is a chance that their confidence fluctuates throughout stages of problem solving. This finding supports the idea that

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there should be a tool to identify which stages of problem-solving students have low self-efficacy so that a specific intervention can be made to help those students improve their self-efficacy in all stages of problem solving.

5. CONCLUSION

The study determined distinct self-efficacy indicators for each stage in Pólya's method of problem-solving. These indicators will serve as empirically grounded descriptors for self-efficacy across stages of understanding the problem, devising a plan, carrying out a plan, and looking back. By identifying these stage-specific indicators of self-efficacy, these findings provide clearer framework on how students' behavior reflect their self-efficacy level per stages of problem-solving. The identified indicators offer foundation on future development of self-efficacy tools, as well as providing a guideline for instructional practices to enhance student self-efficacy in solving mathematics problems.

6. RECOMMMENDATIONS

The following are recommendations set to improve and utilize the results of this study:

For researchers, future research should examine the identified self-efficacy indicators across different grade-levels and learning contexts to further determine its consistency and generalizability

For educators, these identified stage specific self-efficacy indicators can be used as observational guides to improve learning experiences of the learners and better understand learners' self-efficacy and engagement during mathematical problem-solving.

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