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The Development of the Growth Mindset of the Eleventh Grade Students Using Open Approach

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Abstract

This research aims to develop the growth mindset of eleventh-grade students using Open Approach. Six students from grade 11 from a school under the Yala Secondary Educational Service Area Office were selected. The students initially had a fixed mindset at levels F1 and F2 and a weak growth mindset at level G1 before the development process. This study is a classroom action research. The instruments of this research consisted of three lesson plans on probability using Open Approach, activity sheets, a mindset assessment form, an interview form, a post-lesson report, a video camera, and a voice recorder. Data analysis was conducted using the mindset framework analysis from the Mindset Works Educator Kit (2012). Percentage analysis and qualitative methods were obtained in the research. The research findings indicated that students who participated in learning through Open Approach showed progress in their growth mindset scores, with 33% reaching level G3, 50% reaching level G2, and 17% remaining at level G1. Students showed behaviors of embracing challenges, demonstrating efforts, solving problems independently, valuing peer feedback as beneficial to learning, and viewing others' success as a source of inspiration and learning examples.

Keywords Perception; Cosmetic; Products.

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1. INTRODUCTON

Although Thailand has long entered the era of educational reform, mathematics instruction in the country still predominantly follows a traditional approach. Lessons typically begin with the direct presentation of mathematical content, including rules, formulas, and principles. Teachers then demonstrate problem-solving procedures, which students are expected to follow step by step before completing practice exercises. This instructional style is comparable to "Talking Mathematics", which not only fails to promote logical reasoning but also discourages students' enthusiasm and creativity (Maitree, 2003, as cited in Suwaranee, 2020).

Additionally, this approach restrains the development of a growth mindset. Students often hesitate to explore alternative methods beyond what the teacher has demonstrated due to a fear of making mistakes. Those who quickly complete numerous exercises are praised as smart by teachers and peers, while those who take longer to think or attempt different methods are often perceived as less capable. Furthermore, students with a fixed mindset tend to assume they are not good at learning because they have not yet discovered the most suitable learning strategies for themselves. When their initial problem-solving methods fail, they may prematurely conclude that they are slow learners or lack academic talents. In reality, their struggles may originate from a lack of supported focusing on problem-solving skills and long enough to identify an effective approach for themselves (Thanandorn, 2022, p. 101).

From the mathematics instruction conducted for Grade 11 students. They consist of various abilities of students. The observation discovered that some students hold negative perceptions toward mathematics. They often express that they are not smart or capable, believing that mathematics is a difficult subject with little relevance to real life. Many students lack foundational mathematical knowledge, and as they progress to higher levels, the subject becomes more abstract. Also, students are accustomed to traditional teaching methods in which they are required to copy problem-solving procedures without being encouraged to actively engage in thinking or expressing their own reasoning. Only high-achieving students feel confident enough to present their solutions in front of the class, while lower-achieving students remain passive, lacking confidence and avoiding problem-solving on their own. These factors influence students' mindsets, reinforcing a fixed mindset toward learning mathematics. To help students develop a more positive attitude toward mathematics, fostering a growth mindset is essential. Encouraging students to embrace challenges, persist in problem-solving, and believe in their ability to improve is crucial for enhancing their learning experience in mathematics.

According to Dweck (2006; 2016, as cited in Piyawan, 2023), a growth mindset is the belief that intelligence and abilities can be developed through effort, practice, and the use of effective learning strategies. Individuals with a growth mindset focus on learning and self-improvement, putting in their best effort without fear of failure. Instead, they view failure as an opportunity to learn and grow. A growth mindset plays a crucial role in learning mathematics. A study suggests that several factors influence students' mathematical mindset. Mathematics is often associated with widely accepted stereotypes, which are reinforced by media portrayals. One common misconception is that mathematical ability is a natural talent or a skill that makes certain individuals stand out. Besides, mathematics grades are frequently perceived as a direction of intelligence. In summary, the general perceptions of mathematics and students' personal experiences in learning the subject often contribute to the development of a fixed mindset**,** where students believe their mathematical ability is predetermined and unchangeable.

Hoeve et al (2023) states that studies on the development of a growth mindset in mathematics classrooms have highlighted its positive impact. For example, research on promoting a growth mindset in secondary school mathematics classrooms in the Netherlands found that the average mindset scores of students showed a trend toward a growth mindset after targeted interventions. This underscores the importance of fostering a growth mindset to make mathematics more accessible to all students. Similarly, a study on the effects of teaching mathematical thinking in the United States revealed that students who were taught to think mathematically developed a more positive belief in their abilities and learning strategies. Teacher interviews further indicated that a critical moment in the classroom occurred when teachers provided students with appropriate tools, allowed them sufficient time to explore multiple problem-solving strategies, and assigned a single open problem for students to solve independently. These factors played a crucial role in shifting students' mindsets and increasing their motivation to engage with mathematics (Boaler et al., 2021). Therefore, an instructional approach that emphasizes student-centered thinking, similar to the aforementioned examples, has been widely recognized in the Thai educational context as Open Approach**.** This teaching method is expected to support the development of a growth mindset in mathematics learning.

Open Approach is an innovative mathematics teaching method that emphasizes self-directed problem-solving, allowing all students to learn mathematics according to their individual potential. Based on the study by Inprasitha (2010)**,** this approach shifts the teacher's role from directly conveying knowledge to presenting open problems without providing prior explanations, as traditionally practiced. Instead, the teacher assumes the role of an **observer**, identifying students' ideas as they work independently to solve problems. These ideas are brought into a whole-class discussion, fostering **interaction and communication** between teachers and students, as well as among students themselves. The process encourages reasoning and reflection on different problem-solving approaches, ultimately guiding the class toward a collective understanding of **learning how to learn.**

Inprasitha (2010, as cited in Suwaranee, 2020) clarifies that Open Approach teaching method consists of four key steps, which are 1) Posing Open Problems – the teacher presents a challenging problem situation that allows students to engage deeply with the problem until they perceive it as their own. 2) Students' Self-Learning – students explore and develop their own methods for solving the problem independently. During this process, the teacher observes and records students' ideas as they work through their solutions. 3) Whole-Class Discussion and Comparison – the teacher organizes and sequences students' mathematical ideas for presentation in front of the class. Students then compare different approaches, analyze relationships, and examine similarities and differences between their own ideas and those of their peers and 4)Summarization through Connecting Students' Mathematical Ideas – the teacher facilitates a discussion that links students' shared ideas with the key mathematical concepts targeted in the lesson plan.

The researcher focuses on developing the growth mindset of Grade 11 students using Open Approach as the learning process in this method which aligns with various aspects of growth mindset development. For example, the posing of open problems presents a challenge to students, encouraging them to engage in problem-solving, the self-learning phase which allows students to focus on the problem, express their own ideas in writing, and overcome the fear of making mistakes. In addition, the whole-class discussion can help students become aware of their own thought processes through teacher-guided questioning as well as the connection of mathematical ideas which enables students to explore multiple problem-solving strategies and discover methods that best suit their learning style.

Research on the development of growth mindsets, such as fostering a growth mindset in secondary mathematics classrooms in the Netherlands, has shown that changes in students' average mindset scores indicate a trend towards a more growth-oriented mindset after the interventions. More importantly, post-intervention interviews and questionnaires revealed that both students and teachers reported a shift in their classroom attitudes toward mathematics. This was evident in their language use and more trusting and caring collaboration. These findings highlight the importance of fostering growth mindsets to make mathematics accessible to all students (Hoeve et al., 2023).

Research on the effects of teaching mathematical thinking to students in the United States has shown that students who are taught mathematical thinking have more positive beliefs about themselves and their own learning. Teacher interviews revealed that key moments in the classroom occur when teachers provide tools and allow students time to solve problems in a variety of ways. Assigning a single open problem and having students think through the solution on their own is a key factor in changing mindsets and motivation towards mathematics (Boaler et al., 2021).

Atthaporn (2022) said that research on the development of growth mindsets in students using **Open Approach** is limited. However, there is related research on the development of attitudes towards mathematics. Research results indicate that learning through Open Approaches promotes positive attitudes toward mathematics, making students feel excited, enthusiastic, engaged, and confident in solving mathematical problems. When teachers provide encouragement and guidance in problem-solving, students develop a sense of pride when they successfully solve mathematical problems on their own, leading to a fondness for learning mathematics and a sense of accomplishment in applying their knowledge to real-life situations.

In conclusion, developing a growth mindset is important for students who are learning mathematics. Conducting the teaching and learning using Open Approach is consistent with developing a growth mindset.

2. METHOD

This research is a classroom action research. Participants were grade 11 students from the second semester of the 2024 academic year in Yala Province. These students were selected based on their mindset scores: they exhibit either a fixed mindset at the F1 or F2 level (characterized by a belief that intelligence is relatively static, a dislike of errors if avoidable, low effort, and a perception that learning should be easy) or a weak growth mindset at the G1 level (uncertainty about the malleability of their intelligence, concern with performance outcomes, a desire to learn but reluctance to exert significant effort). The target group of students demonstrated low foundational math knowledge and skills, and they tend to avoid attempting problems independently.

Instrument

1. Lesson plans
   The study implements Open Approach learning plan for the subject of Additional Mathematics 4, specifically focusing on the topic of Probability. Three lesson plans are designed, spanning a total of four class periods, each lasting 50 minutes.
2. Activity sheets
   Three activity sheets are utilized in the study: "Who Should Get It?", "Cotton Candy Coin Toss", and "Dart Throwing for Rewards". These activities are designed to reflect students' growth mindset during Open Approach learning process.
3. Mindset assessment
   Students assess their mindset both before and after Open Approach learning sessions. The assessment consists of eight questions, with students rating their opinions on a six-point Likert scale (1–6). The scores are interpreted based on the Mindset Assessment Profile (MAP) group criteria.
4. Interviews
   The interview process includes five questions addressing five aspects of a growth mindset: 1) Challenges 2) Obstacles 3) Effort 4) Feedback and 5) Success of others. Students are interviewed after completing the three open-approach lesson plans.
5. Post-teaching reports
   A report is maintained to document observations of student engagement and reflections on each step of Open Approach learning process, with a focus on growth mindset development.
6. Video recording
   A video camera is used to capture students' behaviors during learning activities under Open Approach method.
7. Audio recording
   A voice recorder is used to document student discussions during learning activities and interviews to gather insights into their growth mindset.

Note: Research instruments outlined in **Sections 1-4** are reviewed by a thesis advisory committee and subject matter experts for accuracy, content validity, and alignment with the assessment of growth mindset. If necessary, revisions will be made based on expert feedback. The revised instruments will then be re-evaluated by the thesis advisory committee before being used in the research study.

Data Collection

1. The researcher develops three lesson plans focusing on the topic of Probability.
2. Open Approach learning is implemented in the classroom. Observations are made, and students' thought processes are recorded without interference in the teacher's instruction.
3. After each lesson, reflections are conducted to evaluate the achievement of learning objectives and analyze students' growth mindset development. Adjustments are made for the next lesson if necessary.
4. After completing all three lesson plans, the collected student data is analyzed.

Data Analysis

1. **Quantitative Analysis**

The students' mindset scores before and after Open Approach learning sessions are compared. The evaluation follows the **MAP (Mindset Assessment Profile) group criteria**, which categorize different

levels of mindset development.

Table 1. Interpretation of Mindset Scores

If your profile number falls into this range:	Then your MAP group is:	If your profile number falls into this range:
8 – 12	F5	You strongly believe that your intelligence is fixed—it doesn't change much. If you can't perform perfectly you would rather not do something. You think smart people don't have to work hard.
13 – 16	F4	
17 – 20	F3	You lean toward thinking that your intelligence doesn't change much. You prefer not to make mistakes if you can help it and you also don't really like to put in a lot of work. You may think that learning should be easy.
21 – 24	F2	
25 – 28	F1	You are unsure about whether you can change your intelligence. You care about your performance and you also want to learn, but you don't really want to have to work too hard for it.
29 – 32	G1	
33 – 36	G2	You believe that your intelligence is something that you can increase. You care about learning and you're willing to work hard. You do want to do well, but you think it's more important to learn than to always perform well.
37 – 40	G3	
41 – 44	G4	You really feel sure that you can increase your intelligence by learning and you like a challenge. You believe that the best way to learn is to work hard, and you don't mind making mistakes while you do it.
45 – 48	G5	

Qualitative Data Analysis

Qualitative data analysis involves examining data collected from video and audio recordings during the learning process, interviews, and post-teaching reports. The analysis focuses on describing students' behaviors that reflect the five aspects of a growth mindset: 1) Embracing challenges 2) Demonstrating effort when facing obstacles 3) Viewing effort and dedication as a path to success 4) Perceiving constructive criticism as valuable feedback for learning 5) Seeing others' success as inspiration and a learning opportunity

3. FINDINGS AND DSICUSSIOUN

The study implemented three Open Approach learning plans on the topic of probability for Grade 11 students. After each lesson, students were required to assess their mindset before and after the learning process using an eight-item questionnaire. Each question was designed to reflect different aspects of a growth mindset. Examples of the items include:

- *"I am not good at mathematics and will never excel in it."* (Effort)
- *"I often feel dissatisfied when receiving feedback on my work and performance."* (Feedback)
- *"When I see others who are more skilled, I feel inspired, eager to learn, and apply their strategies to improve myself."* (Success of others)

The results indicate that all students showed an improvement in their mindset scores after participating in Open Approach learning sessions. Their post-learning mindset scores were consistently higher than their pre-learning scores, as illustrated in Table 2.

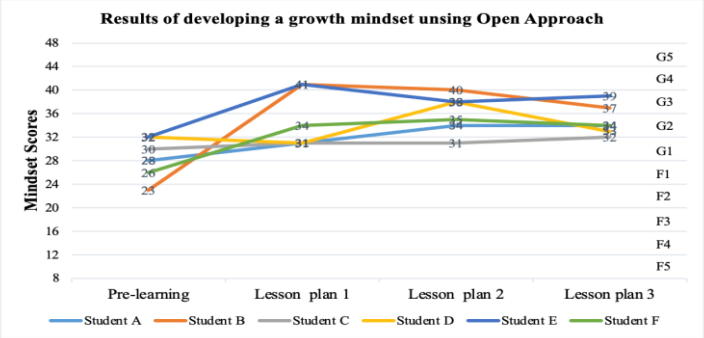
Table 2: Comparison of Students' Mindset Scores Before and After Open Approach Learning

Students	Pre-learning (level)	Post-learning			$\bar{x}$*	Score Difference**
		Lesson plan 1	Lesson plan 2	Lesson plan 3		
A	28 (F1)	31 (G1)	34 (G2)	34 (G2)	33 (G2)	+5
B	23 (F2)	41 (G4)	40 (G3)	37 (G3)	39 (G3)	+16
C	30 (G1)	31 (G1)	31 (G1)	32 (G1)	31 (G1)	+1
D	32 (G1)	31 (G1)	38 (G3)	33 (G2)	34 (G2)	+2
E	32 (G1)	41 (G4)	38 (G3)	39 (G3)	39 (G3)	+7
F	26 (F1)	34 (G2)	35 (G2)	34 (G2)	34 (G2)	+8

* Average Score = The mean mindset score after completing all three Open Approach lesson plans
** Score Difference = Post-learning average score – Pre-learning score

From Table 2, it was found that students who completed all three Open Approach lesson plans exhibited growth mindset levels at G3 and G2. These levels reflect the belief that intelligence can be developed, with a strong focus on learning and effort, prioritizing learning over simply achieving good results.

- G3 Level (*Strong Growth Mindset*) → 2 students (33%)
- G2 Level (*Moderate Growth Mindset*) → 3 students (50%)
- G1 Level (*Limited Growth Mindset*) → 1 student (17%)



Gambar 2. illustrates the development of students' growth mindset using Open Approach.

The graph illustrates that all students exhibited growth in their mindset after participating in the three Open Approach lesson plans.

- Students A and B reached their highest growth mindset level in lesson plan 1, categorized as G1 (*Uncertain about their ability to change their intelligence, focused on performance, interested in learning but reluctant to put in significant effort*).
- Student C achieved their highest growth mindset level in lesson plan 3, categorized as G1.

- Students D and F demonstrated their highest growth mindset levels in lesson plan 2, reaching G3 and G2, respectively. These levels indicate a belief in intelligence development, commitment to learning, willingness to work hard, and prioritization of learning over performance.
- Student E reached the highest growth mindset level in lesson plan 1, categorized as G4 (*Strong confidence in their ability to develop intelligence through learning, embracing challenges, valuing effort as the key to success, and not fearing mistakes*).

Topic Activity: Cotton Candy Coin Toss
Situation: There is a coin box and a wheel with arrows that indicate numbers from 3 to 7.
Instructions: 1. Write the sample space. 2. If the arrow points to an odd number both times, you will be given a free piece of cotton candy and write the result where the arrow indicates the odd number both times.

Step 1: Presenting an Open Problem Situation (Accepting challenges)

Picture 2: Teacher's role while presenting problem situations

Picture 3: Students' behaviors

The teacher introduced a cotton candy vending game, where inserting a coin spins a wheel that lands on a number. The number determines how many pieces of cotton candy the customer receives. If a customer spins the wheel twice and lands on an odd number both times, they receive free cotton candy. Students were then asked to predict all possible scenarios that would result in a free cotton candy reward based on the given conditions. Overall, the students actively participated in the discussion.

During interviews:

- Student A expressed excitement, saying, *"I was eager to see if the wheel would land on the same number again. It made me think further."*
- Student E enjoyed the pre-learning activity, mentioning that it was engaging and prevented boredom. The interactive teaching materials made them curious about what the teacher would do next, as the lesson was not solely lecture-based.
- **Step 2: Independent Learning**
- At this stage, students demonstrated **persistence and effort when facing challenges** and **viewed dedication as the pathway to success.**
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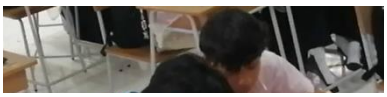
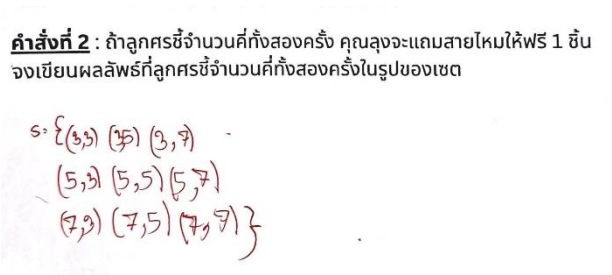
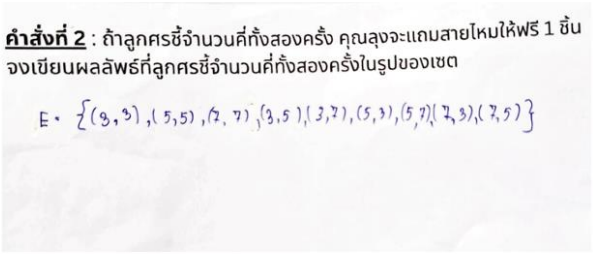


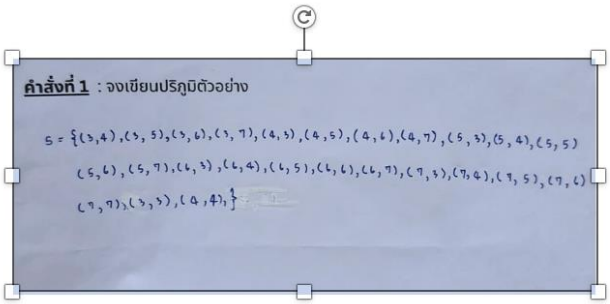
Picture 4: Student C and D while solving the problem





Picture 6: Ideas of student E and G

Student E : I get (3,3) (5,5) (7,7).
Teacher : There is more.
Student G : I see (3,5,7). Is it correct? Because it doen't specific that the same number cannot be found.
Student E : I get it now. It's (3,3), (3,5), (5,3), (5,5), (5,7), (7,3), (7,5), (7,7)



Picture 7: Ideas of student E and G

Student G: Yes! I get the answer. It's (3,3) (5,5) (7,7).
Student E: Why do I get only a few? Oh, I can find more. It's (3,3) (5,5) (7,7).

Picture 8: Presenting ideas in front of the class

Student E gets the same results as the previous group. However, they add duplicate rank pairs such as (3,3) (5,5) (7,7) because when the wheel spins the second time, they may get the same number.

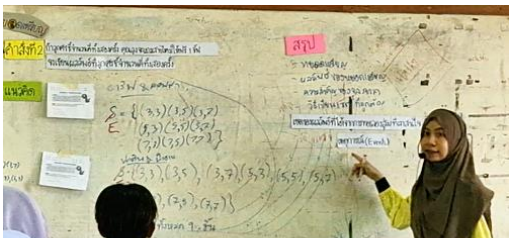
The students demonstrated some feedback, viewing constructive criticism as a valuable learning tool. From the interviews, several perspectives emerged:

- **Student A:** "I now understand where I went wrong. I don't feel bad about making mistakes because we haven't learned this yet."
- **Student C:** "If I make a mistake, I need to correct it. I don't feel upset about it. When friends help correct my mistakes, I see it as a good thing."
- **Student D:** "I now know exactly where my mistake was and what I need to improve."
- **Student E:** "It's normal for peers to point out that my reasoning is incomplete. I appreciate their feedback and don't feel bad about it because it makes sense."

These responses indicate that students perceived feedback as beneficial to their learning process and viewed accurate reasoning as an example to learn from.

Step 4: Summarizing and Connecting Ideas

At this stage, students **recognized the success of their peers as a source of inspiration and a learning opportunity**. The discussion and reflection process encouraged them to refine their own thinking based on their classmates' insights.



Picture 9: Summarized by connecting students' ideas

From the student interviews regarding their feelings toward complete and incomplete ideas discussed in class, Student E shared: *"It is normal for a classroom to have both correct and incorrect ideas. Some students understand concepts differently and apply their own reasoning. It's great when my classmates come up with multiple ways to approach a problem because sometimes I wouldn't have thought of those methods myself. I get to learn new approaches from my peers, and I really like discovering 'wow' methods from them."*

This response highlights the student's **open-mindedness in accepting diverse perspectives** and their **ability to view more complete solutions as examples for learning**.

Recommendations

1. The learning tasks should provide sufficient challenge to encourage students to exhibit persistence and resilience in overcoming obstacles during problem-solving.
2. This study collected data on students' growth mindsets through their verbal responses and behaviors during learning activities. To ensure comprehensive data collection, additional research assistants should be involved in observing student behaviors.
3. Future research should explore the role of teachers in implementing Open Approach strategies that foster the development of a growth mindset in students.

CONCLUSIONS

The analysis of students' growth mindsets revealed that Open Approach contributed to the development of key growth mindset attributes **in** embracing challenges was observed in Step 1: Presenting Open Problems**,** demonstrating persistence and effort in problem-solving**,** even when solutions were initially incomplete, was evident in Step 2: Independent Learning**,** viewing peer feedback as a tool for improvement and recognizing its value in learning was demonstrated in Step 3: Classroom Discussions and Comparisons**,** and seeing well-developed ideas as learning models and drawing inspiration from the success of others emerged in Step 4: Summarizing and Connecting Ideas**.** To conclude, these findings suggest that Open Approach experiences play a significant role in fostering a growth mindset among students.

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